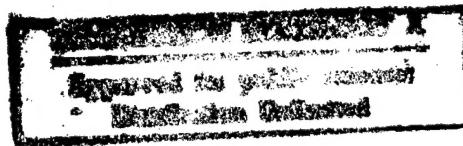


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JPRS-UES-84-001

12 January 1984



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# USSR Report

EARTH SCIENCES

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FOREIGN BROADCAST INFORMATION SERVICE



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12 JANUARY 1984

USSR REPORT

EARTH SCIENCES

FOREIGN BROADCAST INFORMATION SERVICE

REPRODUCED BY  
**NATIONAL TECHNICAL  
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U.S. DEPARTMENT OF COMMERCE  
SPRINGFIELD, VA. 22161

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12 January 1984

## USSR REPORT EARTH SCIENCES

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## METEOROLOGY

### GEORGIAN OFFICIALS REFUTE LOCAL RUMORS OF U.S. 'METEOROLOGICAL WAR'

Tbilisi ZARYA VOSTOKA in Russian 27 Jul 83 p 3

[Interview with T. Turmanidze, chief, Georgian Administration for Hydrometeorology and Environmental Monitoring, and USSR and Georgian SSR Academy of Sciences' Corresponding Member G. Svanidze, director, Trans-Caucasus Regional Scientific Research Institute, by Georgian Telegraph Agency: "Meteorological War? Small Talk"; date and place not given]

[Excerpt] Question: Rumors concerning natural disasters and the ever more frequent occurrences of hailstorms and flooding in this republic have recently been spreading among part of the population. One often hears the following opinion: "The United States is waging a meteorological war with the USSR, and this is the reason for the abrupt changes in the weather." What can you tell us about this?

T. Turmanidze: These rumors are absolutely groundless. True, the United States is waging a war, but it's a psychological one. For example, the White House recently spread throughout the entire world the falsehood that in Southeast Asia, Soviet-produced chemical weapons have allegedly been used, causing "yellow rain" that affects people. The falsehood was quickly unmasked. American scientists themselves disproved this monstrously ridiculous statement made by the Reagan administration for the purpose of diverting the world community's attention away from the destructive consequences of the Pentagon's actual use of chemical weapons in Vietnam and from the United States' current large-scale preparations for chemical warfare. The American scientists proved that the substance on which the "yellow rain" is based is actually bee droppings. Also, by the way, no one has yet succeeded in finding even one person whose skin tissue was affected by "yellow rain."

This talk about meteorological warfare is, if you will pardon my saying so, Philistinism.

Actually, the weather conditions in our republic have been anomalous for the last 2 years. Heavy rains and hail and flooding in a number of areas have inflicted a heavy loss on the national economy. However, the objective scientific information that we have about observations that have been made by meteorological stations for 100 years and more indicates that heavy rains, and flooding, and hailstorms, and hurricane-force winds that were somewhat more severe than those occurring now have appeared frequently in the territory of Georgia. This year there have been no particular deviations from the norm.

It is another matter entirely that until recently, the damage done by hail was a local phenomenon, but now it encompasses large areas. In past years, for example, hail fell only in Kakheti, but now it has damaged large areas in both Kartli and Imereti. The same thing is happening with heavy downpours. In connection with this, the superclouds that discharge the rain and hail have sometimes reached 15-18 km in length.

How do we explain such phenomena, which--by the way--are now typical not only of Georgia, but have been seen throughout the entire world? Any natural phenomenon must be explained scientifically. There is still no unified opinion on this matter, but only hypotheses, conjectures and assumptions.

One of the concepts is that meteorological satellites, as they go into orbit through the upper layers of the atmosphere, penetrate the ozone, which--as is known--protects the Earth from aggressive ultraviolet rays. Part of them reach the Earth through the gaps that are formed and cause undesirable effects. However, this viewpoint still has to be proven scientifically.

I share completely the opinion of scientists and specialists who consider the cause of these weather anomalies to be atmospheric pollution. Intensive discharges into the Earth's atmosphere of carbon dioxide, sulfur trioxide, wastes from fuel burned by airplanes and other flying vehicles, and the exhaust gasses from motor vehicles apparently affect the formation of superclouds that cause hurricane-force winds, torrential rains and falls of hail.

The problem of pollution of the atmosphere is rightfully causing unrest among this planet's scientists. Its solution requires that the efforts of many nations throughout the world be combined.

G. Svanidze: Flooding on large or small scales has been seen in Georgia in various years. The worst flooding ever encountered was in 1922, when heavy downpours covered the entire territory of Imereti, Guriya and Megreliya. There was a catastrophic flood in Kure at the end of the last century that caused a great deal of trouble. Thus, severe flooding has been seen before, is being seen today, and will undoubtedly be seen in the future. It is simply that nowadays we feel the effects of flooding more. The fact of the matter is that we are now making maximum use of river banks for various national economic purposes. Farms and industrial enterprises have appeared and are appearing on river banks. Therefore, even normal flooding has a substantial effect on the complicated mechanism of contemporary life in areas near rivers.

Any type of human economic activity in valleys, on flood plains and in river channels can cause substantial changes in their water regimes. Man can improve the water regime of rivers by reducing the maximum discharge and increasing the carrying capacity of their channels, thereby reducing the possibility of flooding. On the other hand, he can cause river discharge conditions to deteriorate by using our rivers unzealously and without taking into consideration the recommendations of the scientists, thereby increasing the possibility of floods.

Can flooding be prevented? Undoubtedly. For example, in the Rioni area, which is in the Kolkhidskaya lowland, both banks are reinforced with embankments, and after the construction of the Namakhvanskoye and other reservoirs the probability of

floods will be reduced sharply. With the construction of the unique Ingurskaya Dam, spring flooding on the river will cease entirely. Flooding in Kure stopped completely after the construction of the Mingechaurskoye Reservoir. There are many such examples. Large reservoirs are a radical means for fighting floods.

However, reservoirs cannot be built on all rivers. Therefore, it is necessary to carry out systematic projects to reorganize the channels of levees, bridges, canals and other hydraulic engineering structures.

Our institute has been studying the problem of dangerous hydrometeorological phenomena for many years. Our book on this theme, which is of broad scientific and practical value, was published in Leningrad in 1980. At the present time we are studying the consequences of flooding in Georgia, with particular emphasis on Adzhariya, the small rivers in the Inguri River's basin, the basins of the Aragvi, Khrami and Algeti Rivers, and the tributaries of the Alazani River. This research is needed in order to reach scientific generalizations and develop new methods for calculating and predicting floods and providing planning organizations with scientifically substantiated recommendations.

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## PARAMETERS DETERMINING FREQUENCY OF GENERATION OF TROPICAL CYCLONES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 19, No 8, Aug 83 (manuscript received 14 May 82) pp 787-795

IVANOV, V. N. and KHAIN, A. P., Institute of Experimental Meterology, USSR  
Hydrometeorological Center

[Abstract] Previous works suggested a method to correlate regions and frequency of development of tropical cyclones with certain parameters. Based on this method, a phenomenological approach is developed based on the use of a certain criterion dependent on a number of parameters, the seasonal value of which determines the frequency of development of tropical cyclones. The parameters included in the seasonal tropical cyclone potential are analyzed. The parameters include the relative vortexing at low levels, the coriolis parameter, the inverse of the vertical wind shear, the thermal potential of the ocean, the vertical gradient of the equivalent potential temperature from the surface up to 500 mbar and the mean tropospheric relative humidity. The role of each parameter is discussed. An equation is presented for the seasonal cyclone potential defined as the product of two parameters:  $SCP = [(\overline{RH}_n - 40)/7]L_f$ , where RH is the relative humidity and  $L_f$  is the latitude factor, where  $L_f = f$  at latitude not over  $10^\circ$ ,  $L_f = f_{10} = f_{\phi=10^\circ}$  for latitude between  $10$  and  $15^\circ$  and  $L_f = f_{10/4}(5 - [\phi/15])$  for latitude greater than  $15^\circ$ , where  $f$  is the coriolis factor. The seasonal cyclone potential agrees well with the observed seasonal cyclone frequency. Figures 5; references 13: 4 Russian, 9 Western.

[215-6508]

UDC: 551.465.634:551.52:551.510.4

## REACTION OF OCEAN TO CHANGES IN ATMOSPHERIC GREENHOUSE EFFECT

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 19, No 8, Aug 83 (manuscript received 8 Feb 82) pp 892-895

BYUTNER, E. K., State Hydrologic Institute

[Abstract] Significant changes in the atmospheric greenhouse effect may occur in the next few decades as a result of the increasing content of carbon dioxide gas in the atmosphere. An equation is suggested for calculation of the new equilibrium surface temperature of the earth which will result. The characteristic time of increase of the thermal impulse  $\Delta F_x$  caused by anthropogenic increases in  $\text{CO}_2$  content in the atmosphere is calculated to be 20-40 years. This is significantly greater than the thermal relaxation time but much less than the time of reaction of the ocean as a whole. Using this fact, an equation is written for the change in heat content of the ocean under the influence of the external thermal impulse. The model of the reaction of the ocean based on this equation is suitable to describe changes in the planetary temperature over periods of time of several decades until the temperature field of the ocean as a whole is restructured under the influence of the changing meridional temperature gradient. Figures 3; references 9: 6 Russian, 3 Western.

[215-6508]

UDC: 551.521.14

## ILLUMINATION OF THE SURFACE AND PLANETARY ATMOSPHERIC ALBEDO WITH NEAR-CONSERVATIVE SCATTERING

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 19, No 8, Aug 83 (manuscript received 7 Dec 81; after revision 11 Jun 82)  
pp 813-823

DLUGACH, Zh. M. and YANOVITSKIY, E. G., Ukrainian Academy of Sciences, Main Astronomical Observatory

[Abstract] In an atmosphere of arbitrary optical thickness it is sufficient to introduce two functions assuming conservative scattering to calculate the planetary albedo and illumination of the planetary surface with near-conservative scattering. If yet another function is introduced, the total quantity of energy absorbed by a column of atmosphere of unit cross section can be determined. This work presents the corresponding equations and calculates these functions for the most characteristic optical parameters of the atmosphere. Tables of these functions are presented for the Rayleigh and Henyey-Greenstein scattering indices for a broad range of optical atmospheric thicknesses. References 7: 4 Russian, 3 Western.

[215-6508]

LABORATORY MODELING OF SYSTEM OF MAIN WAVES CREATED BY TROPICAL CYCLONE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 272, No 6, Oct 83  
(manuscript received 12 May 83) pp 1348-1350

ALEKSEYEV, V. V., MELESJKO, A. N. and SUGREY, V. I., Moscow State University imeni M. V. Lomonosov

[Abstract] Energy-active zones in the ocean coincide with zones of strong storm activity. Instrumental measurements for collecting data on the field of hurricane parameters in situ are exceedingly difficult, suggesting the need for laboratory modeling of tropical cyclones. This article describes an experimental apparatus for physical modeling of the system of main waves created by a tropical cyclone. A convectional flow was created by a fan; a grid was used to break up the flow; 12 plates situated along the perimeter controlled the intensity and degree of spiraling of the eddy flow. A chamber with a diameter of 90 cm is situated directly over the surface of a basin measuring 3 x 4 m and having a depth of 3 m. A survey of surface waves was made through a side window in the basin wall at an angle of 32° to the water surface. A photographic image of the wave structure forming at the water surface with different entry angles ( $\theta$ ) of the plates and two different vertical heights (25 and 10 cm) was obtained. For example, with  $\theta=0$  (a case corresponding to the equator) the air flow does not spiral and only a region of low pressure is created over the water surface, whereas with  $\theta = 68^\circ$  a rotating spiraling wave is formed at the surface. It is shown that the phenomenon can be modeled for both the northern and southern hemispheres. The modeling revealed, for example, that with an increase in the entry angle the wave structure under the air eddy exhibits an increase in the number of spirals emanating from a common center and at the same time a decrease in the angular frequency of rotation of these spirals. A decrease in the height of the plates corresponds to a decrease in the area of the entry flow and thereby an increase in the velocity of rotation of the air eddy; this in turn leads to an increase in the dimensions of the eye and the number of spirals emerging from the core at the water surface. The observations suggest that a tropical cyclone can be regarded as an analogue of a reverberator in chemical and biological active media, a distinguishing characteristic of which is that it is not linked to any permanent structure in the medium. Figures 3; references 6: 5 Russian, 1 Western.

[19-5303]

VARIBILITY OF DIRECT SOLAR RADIATION AND TEMPERATURE IN NORTHERN HEMISPHERE  
AS AFFECTED BY VOLCANIC ERUPTIONS

Leningrad IZVESTIYA VSESOYUZNOGO GEOGRAFICHESKOGO OBSHCHESTVA in Russian  
Vol 115, No 5, Sep-Oct 83 pp 401-411

LOGINOV, V. F., PIVOVOROVA, Z. I. and KRAVCHUK, Ye. G.

[Abstract] Processing of observations has yielded the mean monthly and mean annual values of direct solar radiation at noon for stations in the USSR and with atmospheric mass  $m=2$  for foreign stations, maximum values of direct solar radiation in the USSR, mean monthly and mean annual scattered radiation with clear sky in USSR mountain stations. To allow comparability of observations by stations located in different climatic regions and latitudes, the ratio of absolute values to multiannual averages was calculated. The anthropogenic factor was estimated and found to be particularly strong in changes in radiation since the mid-1940's. Analysis of changes in direct radiation over identical time periods in the plains and in mountain regions where there are practically no sources of anthropogenic atmospheric pollution allows approximate estimation of the contribution of the tropospheric aerosol of anthropogenic origin. Time periods selected included periods of large volcanic eruptions. The decrease in direct solar radiation after each of the volcanic eruptions studied at the plains stations was greater than in the mountains. It was found that, based on estimates of variability of the transparency coefficient and direct solar radiation, the influence of the Saint Helens eruption was more than 1.3 times greater than that of the Fuego eruption. The estimate of the contribution of volcanic eruptions to the decrease in direct solar radiation averaged over large territories indicates that the Fuego eruption caused a decrease of 2.0%, Saint Helens 2.7%, Agung 3.6%. The influence of the Chichon eruption was still stronger. In 10 months the reduction in direct solar radiation averaged 14% in the plains and 11% in the mountains. The decrease in temperature in the northern hemisphere after eruption of Mount Pelée, Katmai, Agung, and Fuego averaged  $0.08^{\circ}$ , not nearly as great as the variability in mean latitude temperature from year to year. The contribution of anthropogenic factors to the decrease in direct radiation at stations located near populated points has averaged 1.2% per decade. The decrease in direct radiation near the minima of the 11-year cycles in comparison to the maxima is 2 to 3%. References 20: 17 Russian, 3 Western.

[16-6508]

## OCEANOGRAPHY

### SECOND EXPEDITION OF THE NEW SCIENTIFIC RESEARCH SHIP VITYAZ' DESCRIBED

Moscow ZEMLYA I VSELENNAYA in Russian, Sep-Oct 83 pp 48-51

[Article by Doctor of Geographical Sciences A. A. Aksenov]

[Text] The new Vityaz' built at the Szczecin building dock in the Polish Peoples Republic left for its second expedition on 16 April 1982 from Novorossiysk. The scientific research ship assumed a course into the Atlantic. It possesses 26 scientific laboratories containing special equipment and a new hydraulic deck winch control system, and there is a high-capacity U-frame and a slip at its stern. The diving complex consisting of pressure chambers and a diving bell--an important part of the ship's equipment--is intended for work at a depth down to 250 m (ZEMLYA I VSELENNAYA, No 6, 1982, p 60.--Editor).

During the first cruise of the Vityaz', which occurred in February-March 1982 in the Mediterrean Sea and Atlantic, the main objective was to thoroughly test the diving complex, while the main objective of the second was, besides fulfilling a scientific program, testing the deck and laboratory equipment. The scientific program of the second cruise consisted of three basic sections: hydrological studies in the vicinity of the Gulf Stream under the "Razrezy" ["Cross Sections"] program, biological research under the "Ekosistema" ["Ecosystem"] program, and experimental projects--testing a measuring system intended to record high-energy cosmic particles within the water column. Moreover a group of geologists and botanists did work during the expedition.

The preparatory phase occurred in the zone of the Oceanographer Fracture of the Mid-Atlantic Ridge. Deck fittings were tested and adjusted, and sets of winch cables were prepared here.

The "Razrezy" program foresees meticulous investigation of several energy-active regions of the World Ocean. In them, according to available data, energetic interaction of the ocean and the atmosphere is the most intense. Significant anomalies in the thermal state of the atmosphere arising within such zones persist for a long period of time and predetermine weather in land areas quite far away from them. Anomalies in the vicinity of the Gulf Stream are known to directly influence weather in Europe. It is very important to study the mechanism of this phenomenon and to develop the method of long-term weather prediction. Concrete calculations were made in the course of preparations for the "Razrezy" program. It was established that temperature anomalies arising in the vicinity of the Gulf Stream manifest themselves in Europe several months later.

The expedition measured water temperature and salinity to a depth of 2,000 m on three hydrological cross-sections. Meteorological measurements were made concurrently. As a result, quantitative estimates were obtained of the heat exchange between the ocean and the atmosphere in the presence of different synoptic conditions. A significant temperature anomaly which possibly manifested itself in the winter of 1982-1983 in Europe was recorded.

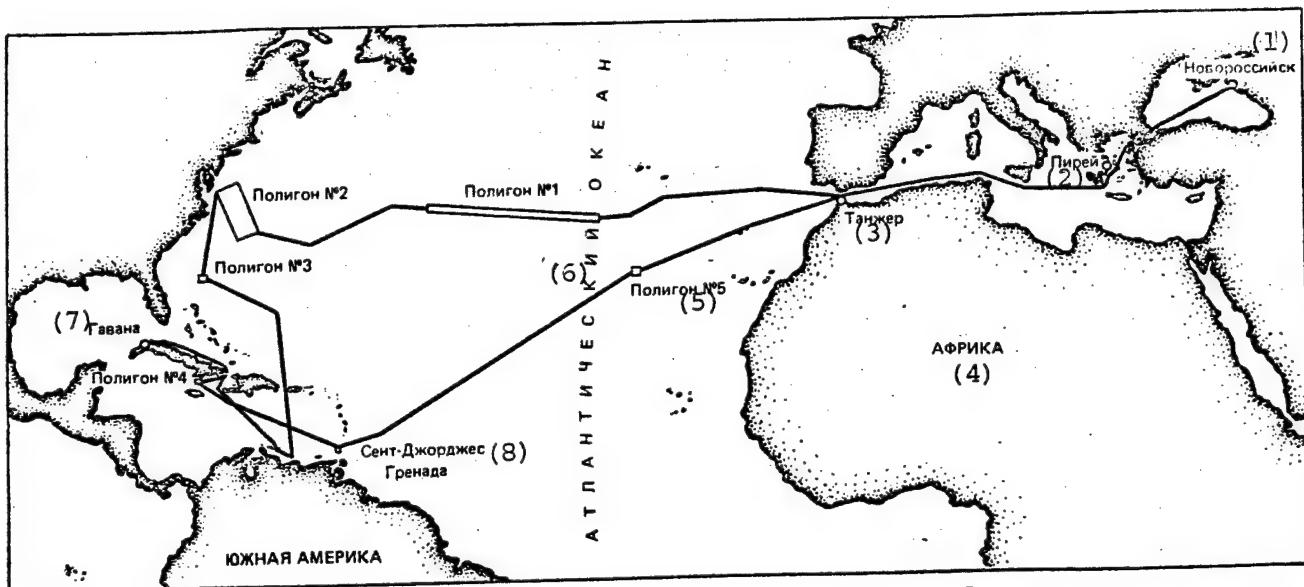
It is an extremely difficult thing to make measurements in the Gulf Stream. It would be sufficient to point out that this powerful current is 100 km wide, it extends to a depth of 2 km, and it moves at a velocity of 2-2.5 m/sec. The expedition aboard the Vityaz' performed a hydrological survey in the spring season. Making a series of measurements that would cover different seasons of the year and different synoptic conditions is required. Similar operations are being conducted systematically in several other areas of the Atlantic and Pacific oceans.

The expedition's biologists conducted research under the "Ekosistema" program at several seamounts, and with especially great detail at the Great Meteor Tablemount; its flat summit is almost 300 m beneath the water. There is important practical significance to biological investigation of underwater ridges and seamounts in the open ocean. Commercial accumulations of fish are known to exist in the vicinities of seamounts. The open part of the ocean beyond the 200-mile limit is the property of all mankind, and the regime of the high seas is observed here.

If new fishing areas are to be exploited sensibly, the reserves of commercial fish and their feed base must be determined, and the general laws governing formation of these unique "oases" within unproductive waters of the open ocean must be studied. Biologists of the expedition studied the benthic fauna on the summits of seamounts and slopes, and the composition and distribution of fish, benthos and plankton. A large commercial trawler was used quite successfully here in addition to traditional fishing gear employed in scientific research. As a result our notions of the composition of the ichthyofauna widened significantly, and we obtained important data on benthic fauna and deep-sea fish.

Still dominant today is the idea that seamount fauna is deep-sea fauna that had populated the slopes and gradually moved to relatively shallow depths. These ideas are in fact valid in relation to seamounts of Antarctica. However, the materials of the second cruise of the Vityaz' revealed quite categorically that the Josephine and Rockaway seamounts and the rather well-studied Great Meteor Seamount possess a fauna similar in composition to fauna of the shelf and continental slope of the Atlantic Ocean. It stands to reason that final resolution of the issue as to the origin of seamount fauna would require additional material. But the problem itself of seamounts, in its broad aspect, has a great future. Individual expeditions should obviously be devoted to a detailed study of seamounts of the ocean's tropical zone.

The work of the group of physicists was devoted to testing a new measuring system intended to record high-energy particles in the water column. Similar devices exist on land as well, but terrain and the geological structure of



#### Route of the Expedition

##### Key:

1. Novorossiysk	5. Polygon
2. Piraeus	6. Atlantic Ocean
3. Tangier	7. Havana
4. Africa	8. St. George's, Grenada

rock have an extremely great effect on measurements made in deep shafts. Meanwhile the ocean water column is sufficiently homogeneous at great depths, and therefore it is a convenient location for certain kinds of measuring resources. This is the basis of the DYUMAND project, in accordance with which recorders covering a sizable continuous area must be set up at considerable depths (on the order of 5 km). It is extremely important to determine the optimum depths and, more importantly, the optimum area of the entire measuring system. If this turns out to be an area of dozens of square kilometers, the project would turn out to be simply impossible. If the area turns out to be too small, the probability of recording particles would be negligible, and the exposure time of the measuring system would grow correspondingly. The DYUMAND project is not international as yet, but preparations for making it so are proceeding (ZEMLYA I VSELENNAYA, No 1, 1979, p 13.--Editor).

A measuring system consisting of blocks with portholes having a diameter of 80 cm underwent testing during the expedition. The system works independently, and it was lowered to a depth of up to 6 km. Three blocks containing 12 photomultipliers each, a storage battery, a hydrostatic control unit and a recorder were secured to a special frame. The initial submersions of the system revealed that it was completely water-tight and that the measuring systems do turn on at the prescribed depths. The tests were conducted in the deep-sea Cayman Trench, near the south coast of Cuba. The tests proceeded normally at depths of 2, 3 and 4 km, and it was not until the system was submerged to depths of 5 and 6 km that the protective portholes of all three measuring blocks underwent deformation, destroying the lenses of the photomultipliers.

Thus the basic suitability of the apparatus for recording high-energy particles was demonstrated, but the protective portholes must be replaced by more-rigid ones capable of withstanding pressure at great depths.

Geologists gathered many samples of modern deposits, including fragments of petrified foraminiferous ooze. The latter were probably formed during under-water volcanic eruptions.

The Vityaz' visited the Greek port of Piraieus, the Moroccan port of Tangier, Havana and St. George's--the capital of the Republic of Grenada, which had recently become an independent state. Since the year 1650, the small island of Granada and another two tiny islands were French colonies for over 100 years, and in 1783 Grenada became a possession of the British Crown.

During the stayover at the port of St. George's, about 700 Grenadian residents visited the ship. It was also visited by executives of the republic and by Grenadian scholars. The Grenadians exhibited considerable interest in the life of our country. During a press conference ship captain N. V. Apekhtin and expedition chief A. A. Aksenov thoroughly described the Institute of Oceanology of the USSR Academy of Sciences, the tasks facing specialists studying the World Ocean, and the work of the expedition aboard the Vityaz'.

The ship returned to Novorossiysk on 6 July 1982.

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## LONG DURATION DEEP-WATER DIVES IN BARENTS SEA

Moscow PRAVDA in Russian 8 Oct 83 p 6

[Article by V. Chebakov, "Pravda" special correspondent, reporting from Barents Sea]

[Text] The command "Stand by for descent of the bell" is heard over the loud-speaker... The captain's bridge is requesting information on wind waves and currents... The descent director Zakharchenko is reporting...

The geological prospecting ship "Valentin Shashin" in the late spring of this year began drilling of the shelf in one of the regions of the Barents Sea. For the first time distance to the bottom was 250 m. We have already told of the day-to-day life of the "marine geologist" in a previous report. However, the work of the diving service merits a detailed account...

On 1 March of this year the divers V. Moskalenko, V. Arseniy, V. Kondrabayev, G. Matviyenko and V. Litvinov, together with the physician A. Kostinevich, for the first time in the country descended to a depth of 240 m and worked there for a total of more than four hours. The experiment, carried out by specialists of the "Arktikmorneftegazrazvedka" (Arctic Sea Petroleum and Gas Exploration) Trust of the USSR Ministry of the Gas Industry, was implemented on the ship "Sprut." This was not done just to set a record. Its participants were faced with the task of preparing divers for work at great depths for the purpose of supporting geological prospecting ships such as the "Valentin Shashin," carrying out exploratory drilling on the Barents Sea shelf. The depth could be handled due to new equipment -- deep-water diving complexes, the courage, boldness and knowledge of these people.

"What is a so-called prolonged stay -- PS (DP -- dlitel'noye prebyvaniye)?"  
I ask Vladimir Vasil'yevich Zakharchenko, deputy chief of the "Arktikneftegazflot" Administration.

"In traditional diving work," he says, "that is, in a one-time brief dive, man can work, for example, at a depth of 150 m for not more than an hour. At depths greater than 200 m work becomes virtually impossible. The air-helium mixture for breathing and the unusually great pressure act on the central nervous system and the body cannot adapt to them in a short time interval. There is a worsening of the memory, the coordination of movements and analytical functions of the brain. The conclusion is as follows: at great depths work

during a brief stay is ineffective and uneconomical.

With the new method man can stay a long time at great depths without subjecting the body to sharp overloads. He can work tens of times more, over the course of a month being on the bottom daily for about 4 hours...

The deep-water complex on the 'Valentin Shashin' is situated on the lower deck, near the drill rig. The diving bell is an underwater 'elevator.' In the usual sense of the word it has no similarity to a bell. It is a circular steel cylinder of a red color, is 2 1/2 m in height and 1 1/2 m in diameter, having ports, hatches and searchlights for outside illumination.

Alongside, beyond a bulkhead, there are two pressure chambers which are connected to one another and the bell by transfer hatches. There is a living compartment with cots, a table, books, chessboards and even music in one of these compartments, whereas in the other there is a shower, dressing room, lock for the transfer of food, medicine, newspapers and everything necessary to the occupants. The 'descent under water' begins in them. The pressure is gradually raised to correspond to depths of 10..., 50..., 100 meters. About two days have elapsed since the onset of the 'dive.' Vladimir Palayev, Valeriy Aparov, Nikolay Kul'kov and the physician Aleksandr Kostinevich are in the pressure chamber. The same who participated in the descent to 240 m on the 'Sprut'."

"How do you feel, how is your feeling of well-being?" I ask Vladimir Palayev, the operator of the diving bell.

"Normal," we hear over the loudspeaker. "Aleksandr Mikhaylovich Kostinevich watches us attentively."

I talk with the divers from the control panel situated in the adjacent room. The electronic technician Vyacheslav Semenov turns on the telemonitor and on the screen I see the living compartment with the divers present inside. They can live in this room with a volume of 15 cubic meters for about a month, proceeding to the bottom for implementation of the formulated tasks.

Preparations for storming of the depths are proceeding before my eyes. Each day the divers emerge from the bell into the water, each time diving deeper and deeper and thereby adapting the body to the ambient pressure. The "bottom" for the time being is simulated by a suspended metal platform on which one can stand and perform different types of work. It is suspended under the bell on strong chains.

"What work awaits the divers below?" I asked Aleksandr Golubkov, chief of the underwater complex.

"As is well known," stated A. Golubkov, "our ship at the time of drilling of an exploratory borehole is held at a point by means of a dynamic positioning system. Hydroacoustic sensors, permanently installed on the bottom, send pulses to the shipboard electronic computer. The signals are processed, and taking into account wind velocity, currents and other factors, set the operating regime for the ship's rudder. As a result, the ship is in the stipulated place, its

position controlled by a modern navigational system. During the time of drilling these sensors can be washed away from the borehole together with bottom material. In this case a decision is made for divers to descend for their inspection, cleaning or replacement. From time to time the need arises for checking the position of the plate at the borehole mouth, the preventer or the drainpipe installed in the borehole."

"And how can this work be done without divers descending?"

"Sometimes it is possible, but this would require cessation of drilling, the raising of the sensors and removal from the drilling point. This involves great expenditures. Accordingly, with well-tested diving equipment, an excellent technical state of the apparatus and readiness of the people, the work of the divers accelerates drilling and has a very good economic effect..."

A second doctor, a physiologist, Vadim Ryzhov, working "on the outside," inspects newly obtained electrocardiograms. The physicians and instruments attentively monitor the health of the divers.

"The work of a diver," he states, "is characterized by the following words: threatening, dangerous and difficult. In selecting people the emphasis is on health. It must be reproachless. Virtually the same as for cosmonauts. Special care is also exercised in selecting the physicians, but there are still higher requirements than on the divers themselves. In case of necessity a physician must enter the pressure chamber, that is, 'descend to the deeps,' considerably more rapidly. Therefore, my 'dives' with Kostinevich were as much work, as, shall we say, monitoring of health..."

The transpolar diving service is relatively young. But here in Murmansk already for several years there has been a strong body of specialists: V. V. Zakharchenko, E. V. Cheremanov, V. A. Vishnyakov and A. G. Klepatskiy. It can be said that the latter two are legendary figures. They have tested the diving gear which we have in our country and each has worked under water more than 8,000 hours. They have many inventions, aids and textbooks to their credit. These are well-disciplined persons, but having great organizational abilities, capable of creating an iron discipline in a group. It is impossible to work without it either up top or down below. As a result, the diving service of the "Arktikmorneftegazrazvedka" Trust has trained dozens of new young specialists for the deep-water complexes of their branch...

At this time the lads have put on their diving suits under the shower. First one, and then a second over it. The lungs are rubberized. Hot water will flow between them, heating man in the icy water. The helium-oxygen mixture must also be rigorously maintained in a temperature regime.

The bell descended.

"Check the watertightness..."

"Check the hatches..."

"Oosh...Oosh..." is heard over the loudspeaker at the control panel. This is the sound of the divers breathing.

"The most comforting sound in the world," says Vladimir Vasil'yevich Zakharchenko.

The exhausting minutes of descent. And now the figure "100" lights up on the digital display. This is the depth.

"Watch the hatch cover, it is now opening," says the descent director.

"We're watching," says Palayev, "It has opened!"

On the monitor screen we watch in complete silence as the divers emerge from the bell onto the platform. They are emerging for the time being for training work in hydrospace. Time will pass and if necessary the bell will reach a depth of 300 m. They will be ready for such a depth. Meanwhile training work goes on...

The other day a radiogram was received at the USSR Minstry of the Gas Industry from aboard the diesel-electric "Valentin Shashin." It read: "A group of divers for the first time has reached the bottom at a depth of 250 m and has implemented the assigned work"...

Still another new step has been taken into hydrospace. But there is far to go  
...

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'OKEANOLOG' MANNED SUBMERSIBLE OPERATING OFF VLADIVOSTOK

Moscow SOVETSKAYA ROSSIYA in Russian 5 Aug 83 p 6

[Article by D. Shevchenko, Vladivostok-Moscow: "We Go Into the Depths"]

[Text] As the continental reserves of minerals become depleted throughout the world, interest in the sea bottom's riches is increasing. Manned submersibles are being used more and more extensively to search for underwater deposits. With their help, in our country we have compiled (in particular) sets of maps of the bottoms of the Sea of Japan and the Sea of Okhotsk, and are finishing the compilation of a geological map of the entire Far Eastern shelf.

A quiet inlet on the outskirts of Vladivostok. We are on the shore, which is backed up by green, cone-shaped hills and rocky cliffs. The people who have gathered here are looking at an unusual object that, to the eye, resembles the well-known "flying saucer."

Right now it is swinging in the air, suspended from the boom of a floating crane. It has smooth, streamlined sides, is colored a bright orange and white, and has a small superstructure that resembles a deckhouse. The crane lowers it into the water. A tugboat approaches it, hooks up and tows it out into the middle of the inlet. Several people then board the "saucer" from the tugboat. The first hydronaut is tall and has broad shoulders and a grey beard. His name is Boris Ivanovich Vasil'yev. He is a doctor of geological and mineralogical sciences and is head of the Department of Marine Geology of the Pacific Ocean Oceanological Institute of the USSR Academy of Sciences' Far Eastern Scientific Center.

"What you see," said the hydronaut, "is the latest in a series of submersibles that have been built in this country. Previously, we were successful in operating the 'Sever-2,' 'Tinro-2' and 'Argus,' among others. Recently, after tests in the Black Sea, the 'Okeanolog' was assigned to our institute. It is notable for its increased maneuverability and is equipped with a manipulator that simulates the movements of the human hand and is capable of gathering samples of sedimentary rocks with a special scoop, break rock samples weighing up to 20 kilograms off outcroppings and place them in containers, and place instruments on the bottom very accurately. On board there is magnetic recording equipment, as well as still and moving picture cameras. The crew numbers three: the commander, the senior operator and an underwater observer."

"What methods are you using to study the ocean bottom?"

"Mainly geophysical ones. We're also using drilling, but primarily in the shallow-water areas. As for geological methods, until recently they were used to study rocks brought up by dredges. However, this method doesn't yield any information about the bedding of rocks and is suitable for local investigations only. But with submersibles, we--the geologists--can go down straight to the objects we're investigating and take pictures. In a word, we can do almost everything that is done under normal conditions on dry land."

"What investigations have you conducted recently with the help of the 'Okeanolog'?"

"We obtained some interesting information on six recent dives in the Black Sea. It turned out, for example, that the continental slope in the area of Novorossiysk consists of rocky fault scarps, the layers of which slope toward the sea. This is a clearcut case for geological analysis.

"Our underwater voyages in the Sea of Japan have also yielded a pretty good bag of information. We've gathered samples of sediments and bedrock and taken pictures of the sea bottom and its inhabitants. As far as I'm concerned, the most impressive thing we've done is to investigate the structure of an underwater canyon that cuts through the continental slope to the south of Cape Gamov. The secret of the origin of this underwater depression has been puzzling scientists for a long time. We succeeded in determining that it is a prehistoric river system that was inundated by the sea. We investigated the ancient river's tributaries, its banks and the flat bed that was its bottom."

The orange and white submersible, the hatch of which closed behind the last hydronaut just a few minutes ago, starts moving. I see a small bow wave. The craft submerges. Five hours from now I will return to this place to meet Boris Ivanovich and his colleagues again. Five hours is the norm for working under water. It is the work day, as determined by physiologists and hygienists.

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CSO: 1865/204

'TINRO-2' SUBMERSIBLE CONDUCTING FISHERIES RESEARCH

Moscow PRAVDA in Russian 19 Aug 83 p 6

[Article by N. Bratchikov: "It Was as Clear as Day"]

[Text] The submersible Tinro-2 took part in tests at the bottom of Peter the Great Bay on long-line fishing equipment developed by scientists at the Pacific Ocean Institute of Fisheries and Oceanography.

The Rimskiy-Korsakov islands, a prohibited zone, sparkled under the long-awaited sun after endless typhoons, tedious drizzle and impenetrable fogs. The steep coasts were covered with greenery, seagulls soared with high rejoicing in the open space and young seals in shiny coats crawled out of the sea to sun themselves on the heated rocks. Our motorship, the "Gidronavt", went past without frightening the animals and stopped near Rikord island where its "mate" for the experiment, a fishing seiner, was already drifting. At down it had already cast its long-line with a length of almost a half mile into the crystal clear water. At both ends of the long-line, warning markers rocked rhythmically.

The "Gidronavt" took up its position. And then over the ship's intercom came the order: "Get ready to lower the submersible."

Man's entry into the oceanic depths is akin to space travel. The deck is, in a way, similar to the launching pad of a space center. The enormous roof of the hangar trembled and shifted to the side revealing in the depth of the hold the bright yellow body of the submersible.

From the deck launching pad to the exit hatch walked, in their thermal clothing, the hydronaut Yu. Sidorenko and the biologist-observer and inventor of the long-line, G. Aduyev. After they had disappeared, one after the other into the narrow manhole, the mechanic-adjuster Yu. Drobzhev secured the cover.

"Test all systems," commanded the Captain of the submersible, M. Girs.

He was standing on the upper deck and over his shoulder was a miniature walkie-talkie.

In the glassed-in cabin, the mechanic Podchinchenov switches on the up and down hoist apparatus extending high above the ship. It grips the submersible and carefully lowers it into the water.

In which of the world's seas and oceans has this yellow all-terrain sea-bottom device not operated? It was created ten years ago especially for research on the fishing resources of the Far East and was put to the test in the north on the carrier-ship "Ikhtiandr", was based at Kerch, made voyages in the Black Sea and went into the Atlantic and Indian oceans. Then it worked on the seabed in the Japan, Okhotsk and Bering Seas. The hydronauts showed scientists the undersea world as it really is: with indescribable beauty, many types of living beings and with complex interrelations among the marine organisms.

The undersea device can, without damaging the surrounding landscape, reveal the true picture of shelf conditions: soil composition, dimensions, numbers and forms of organisms, the locations of their dwellings and their capacities for movement. This type of data is useful not only for the rational organization of fishing but also for artificial rearing of maritime products. The submersibles made it possible to observe extraction equipment: how does it behave underwater and does it damage the bottom flora and fauna during operations.

Tinro-2 exactly carried out this task during its last trip in the Sea of Okhotsk. In the final stage, it moved to Peter the Great Bay in order to test the working possibilities of the new long-line fishing equipment.

And here is the submersible like a giant yellow pike with lateral fins and rounded tail as it moves quickly away from the side of the "Gidronavt" leaving behind a foaming track. By radio can be heard, "Depth 30, 40, 50 meters."

The submersible is to start from the center of the long tow rope which is suspended by means of floats and will attain a level two meters from the bottom. The long-line has baited hooks and this equipment is to be attentively studied.

The deeper you go, the dimmer the twilight is. Yu. Sidorenko turns on the exterior lighting and the horizon of visibility immediately expands. Schools of small fry hasten about, the glass-like parachutes of medusae can be seen like snow flakes and small organisms gleam in front of the glass.

From above is heard, "There are 140 meters to go to the long-line."

The green vegetation of the boulders gives way to a sandstone bottom with the dark arabesques of deposits. Suddenly, before the nose of the submersible there was a give-meter high rock. Sidorenko brought the craft sharply upwards and past the portholes sail, as if giant asters were blooming, colonies of ascidians and the pointed tentacles of starfish. The hydronaut had to use all his attentiveness and experience in order to avoid smashing the submersible on the stone dagger.

Five o'clock in the evening. Through binoculars, the hydronauts can be seen clearly at the surface as they direct the submersible towards the ship.

"The experiment with the new long-lines showed that it is not necessary to place them on the seabed," says G. Aduyev. "In the experiment, starfish, ophiuroids, octupi and shrimp threw themselves on the bait; but fish did not approach it. We proposed a mobile variant of the equipment. The fish will go to the bottom

and the long-line will go after it. When the fish goes up for feeding at night, the long-line will not remain behind. The submersible showed that it was not necessary to keep the equipment under water for six or seven hours and that three are enough."

The weary hydronauts are waiting for showers, a good snack and some rest. Meanwhile, with M. Girs, we go up to the submersible from which the salt water is still streaming. Michael Igorevich, who was the first to test and command the Tinro-2, stroked the yellow fins and recalled his first experience in the depths.

"Observations from the submersible," he said, "opened great possibilities for ichthyologists who were interested, first of all, in how changes in fish behavior depend upon external conditions and the time of day. It is important to know when they eat, when they assemble in schools and many other things."

In the submersible's "work book", there are thousands of miles on the seabed, hundreds of plunges and several scientific discoveries. The hydronauts observed the operations of trawls and the arrangement of different traps for crustacea, mollusks and the accumulation of plankton and studied the continental shelf bed.

Our conversation with the first commander of the Tinro-2 continued during the entire passage of the carrier-ship. The ship was headed towards Posyet in the southern part of the Primorya. In the 200-meter depths, M. Girs and his co-workers of the Pacific Ocean Scientific Research Institute of Fisheries and Oceanography will carry out tests of new deep-sea fishing equipment.

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## RADIATION TIDES IN OCEAN AND ATMOSPHERE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 271, No 5, Aug 83  
(manuscript received 1 Feb 83) pp 1226-1230

KULIKOV, Ye. A. and RABINOVICH, A. B., Sakhalin Scientific Research Institute, Far Eastern Scientific Center, USSR Academy of Sciences, Novoaleksandrovck, Sakhalin Oblast

[Abstract] A study is made of the causes of formation of higher radiation tidal harmonics. By expanding the Legendre polynomials from an equation originally suggested by Cartright and Taylor for theoretical calculation of long-term, diurnal and semidiurnal components of the radiation potential, a set of tidal functions is derived. It is considered that the higher-order radiation harmonics are related to the nocturnal truncation of the radiation potential. The presence of odd harmonics in the spectrum results from the semidiurnal component of the radiation potential, while the even harmonic components are produced by the diurnal components. A variety of mechanisms are discussed for generation of radiation tides in the ocean, including direct radiation pressure, the solar wind, heating and cooling of the ocean surface and breezes. Measurements showed that the amplitudes of the atmospheric tides were only one-fourth to one-eighth as great as the radiation tides in the ocean. In spite of the doubtless connection between radiation fluctuations in the atmosphere and the ocean, these great differences in amplitude indicate that the connection is clearly not hydrostatic. Figures 3; references 10: 2 Russian, 8 Western.

[3-6508]

UDC 551.465.433:551.466.713

## VARIABILITY OF SEMIDIURNAL SPEED FLUCTUATIONS IN THE OCEAN

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 19, No 7, Jul 83 (manuscript received 17 Sep 81; after revision 14 Oct 82) pp 716-723

CHIGRAKOV, K. I., Ukrainian Academy of Sciences, Marine Hydrophysical Institute

[Abstract] An analysis is presented of the properties of semidiurnal fluctuations in speeds of ocean currents, extracted directly from measured data by

means of an analytic filter with resonant amplitude-frequency characteristic. The algorithms suggested allow the properties of continuous evolution of quasiperiodic speed fluctuations to be studied. The fluctuations were found to be significantly variable in both time and space. The examples presented explain the fact that the coherence of tidal semidiurnal fluctuations in speed in the ocean at closely located points is frequently unexpectedly low. Determination of the factors causing the evolution awaits the accumulation of additional data for detailed analysis of the background conditions during the experimental period. Figures 5; references 13: 9 Russian, 4 Western.

[208-6508]

UDC 551.465.11

#### CALCULATION OF VERTICAL SPEEDS IN OCEAN CURRENT MODELS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 19, No 7, Jul 83 (manuscript received 12 May 82) pp 730-740

SARKISYAN, A. S., DEMIN, Yu. L., and TRUKHCHEV, D. I., Department of Computational Mathematics, USSR Academy of Sciences; Institute of Marine Studies and Oceanography, Bulgarian Academy of Sciences

[Abstract] Using two diagnostic models which differ greatly in their hydrodynamic completeness, quasigeostrophic and nonlinear models, a number of numerical experiments are performed to determine the vertical speed in ocean currents by various methods. All calculations are performed for the western Black Sea from 42 to 43°45' N from the Bulgarian coast to 29°30' E. The grid interval used was 5 nautical miles. Twelve calculation depth levels were used, from 0 to 1800 m. Initial data on density were obtained during a voyage of the research vessel "Orbel'" in the fall of 1976. The wind field used was the typical field for autumn, bottom relief taken from a bathymetric map and supplemented by measurements performed by the research vessel. The degree of hydrodynamic completeness and coordination among the equations in the model are found to have the greatest influence on the results of calculation. The field of vertical velocities is one of the most precise criteria for evaluation of the quality of a numerical model. More reliable conclusions concerning a method of its calculation can be obtained by prognostic calculations, maintaining hydrodynamic coordination of density fields with wind fields and bottom relief. Figures 2; references 12: 10 Russian, 2 Western.

[208-6508]

UDC 551.465.11

## INTERACTION OF SYNOPTIC SCALE OPEN OCEAN VORTICES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 19, No 7, Jul 83 (manuscript received 21 Apr 82; after revision 11 Jun 82)  
pp 750-760

SEYDOV, D. G. and YUSHINA, I. G., USSR Academy of Sciences, Institute of  
Oceanography

[Abstract] Synoptic vortices redistribute the concentration of momentum,  
energy and heat and support the interaction of spatially distributed areas of  
large-scale circulation. The interaction of synoptic vortices can generate or  
reinforce mean currents. The primary synoptic structures of currents in the  
open ocean are generated by the interaction of vortices with each other and  
with stream currents, while the large-scale background flow only supplies  
kinetic energy to these formations by baroclinic instability processes. A  
model of elementary interactions in the open ocean suggested in an earlier  
work greatly simplifies the problem of studying elementary interactions in the  
open ocean, reducing it to solution of a single prognostic equation to calculate  
the integral vortexing of currents and a single diagnostic equation to determine  
the full current functions. Computer-generated vector diagrams are presented  
to illustrate the interaction of various synoptic-scale vortices. These inter-  
actions make up the connection between small-scale and large-scale structures.  
Differential rotation of the atmosphere is found to be the most significant  
factor in the elementary interactions. Figures 4; references 8: 7 Russian,  
1 Western.

[208-6508]

UDC 551.465.75

## INFLUENCE OF STRATIFICATION OF BOTTOM ATMOSPHERE LEVEL ON ENERGY IMPARTED TO WAVES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 19, No 7, Jul 83 (manuscript received 14 Dec 81) pp 765-767

MAKIN, V. K., USSR Academy of Sciences, Institute of Oceanography

[Abstract] A study is made of the interaction of wind waves with the temperature-  
stratified atmosphere. The numerical model of the interaction of the turbulent  
air flow with stationary monochromatic waves developed in a previous work is  
modified to describe the stratified layer of air near the water. A simpler  
scheme for closure of the averaged equations of motion is used, but similar  
results are achieved. The energy flux to the waves is formed near the surface  
of the waves. Consideration of stratification of the bottom layer of the  
atmosphere results in a change in the velocity field and consequently the  
pressure field. The change in energy imparted to the waves when stratification

is present results from a change in the correlation of the surface pressure field with the wave surface. With sufficiently high values of L, stratification has no influence on the formation of the energy flux to the waves. With wave development parameters corresponding to developed ocean swells, stratification has a strong influence on the flow of energy to the waves. References 4: 2 Russian, 2 Western.  
[208-6508]

UDC 551.465.4

LABORATORY STUDY OF INTERACTION OF SPOTS OF AGITATED FLUID SPREADING IN STRATIFIED MEDIUM

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 19, No 8, Aug 83 (manuscript received 6 Aug 82) pp 888-891

ABRAMYAN, T. O. and KUDIN, A. M., USSR Academy of Sciences, Institute of Oceanography

[Abstract] A single event involving interaction of elements forming the microstructure of the ocean was studied on a laboratory installation: viscous spreading of a pair of spots of a mixed fluid in a stratified medium. It was found that the spots repel each other and do not merge. The experimental study involved the spreading of a pair of identical cylindrical spots of a mixed fluid of constant volume flowing viscously in a linearly stratified fluid in a 380 x 180 x 50 mm tank filled with an aqueous solution of common salt at room temperature. A linear increase of salinity with depth was verified with a holographic interferometer. Time-lapse photographs of the spreading of the spots are presented. The results can be used to predict the complex island structure of the fine structure of the ocean. Figures 4; references 8:  
5 Russian, 3 Western.  
[215-6508]

UDC 551.465.11

METHOD OF CONTOUR DYNAMICS IN MODEL PROBLEMS OF TOPOGRAPHIC CYCLOGENESIS IN OCEAN

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 19, No 8, Aug 83 (manuscript received 31 May 82) pp 845-854

KOZLOV, V. F., USSR Academy of Sciences, Far Eastern Scientific Center, Pacific Ocean Institute of Oceanography

[Abstract] This article develops the method of contour dynamics for problems of topographic cyclogenesis at sea. A new computational algorithm is suggested allowing more precise and effective description of the behavior of contours

limiting liquid areas with constant vortexing. Examples of evolution of homogeneous vortices of nonelliptical cross section, of the generation of vortex systems with constant flow of both circular cylindrical underwater obstacles, and of the instability of stationary configurations of captured topographic and displaced free vortices are studied. The computational algorithm involves a spline approximation of parametric representations of the contours and a systematic transition from their markers to others in order to preserve their uniform distribution over the boundaries of the vortices. The method can be extended to the case when disturbances of bottom relief are modeled by a set of superimposed right cylinders of different heights. The problem in this case is reduced to the study of the movement of a system of inscribed contours, on each of which the parameter  $\sigma$  is proportional to the height of the corresponding elementary cylinder. The method can thus be useful and effective for solution of a variety of model problems related to the dynamics of quasi-geostrophic vortices in the ocean. Figures 5; references 8: 5 Russian, 3 Western.  
[215-6508]

UDC 551.466.4

#### STABILITY OF WIND WAVES WITH WEAK WIND

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 19, No 8, Aug 83 (manuscript received 19 Apr 82) pp 855-859

RUVINSKIY, K. D. and FREYDMAN, G. I., USSR Academy of Sciences, Institute of Applied Physics

[Abstract] A study is made of a realistic wind model. It is considered that the growth of the waves is limited by generation of capillary-gravitational waves. This mechanism of nonlinear limitation is predominant for short wind waves in the 3.5-30 cm band. The nonlinear decrement due to generation of capillary-gravitational waves depends strongly on wind wave frequency. Its dispersion must therefore be considered. Consideration of the dispersion of nonlinear attenuation can lead to instability of stationary wind waves in the area of their parameters in which the waves are stable if the dispersion of the decrement is not considered. Figures 2; references 7: 4 Russian, 3 Western.  
[215-6508]

VERTICAL STRUCTURE OF CURRENTS AND HYDROLOGIC ELEMENTS IN CENTRAL RED SEA

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 19, No 8, Aug 83 (manuscript received 8 Jan 82, after revision 21 Dec 82)  
pp 860-867

KUSHNIR, V. M., KOLTAKOV, Yu. N. and ZAKHAROV, S. Yu., Ukrainian Academy of Sciences, Marine Hydrophysics Institute

[Abstract] During the 22nd cruise of the "Akademik Vernadskiy" in the summer of 1980 measurements of the vertical distribution of hydrologic elements in the central Red Sea at about 23°N were performed in combination with measurements of vertical distributions of currents and speeds of sound with relatively high resolution as a function of depth. The measurements of the vertical fine structure of the Red Sea allowed its peculiarities related to gravitational-inertial waves and local hydrodynamic instability to be studied. The results of the measurements are described. It is found that the maxima in vertical wave number spectra for wavelengths 20-25 m result from gravitational-inertial waves at a frequency which differs from the frequency of purely inertial waves by 10%. There is a clearly expressed vertical wavelength of 20-25 m, whereas in the open ocean this quantity has been repeatedly measured as several times greater. Figures 4; references 15: 10 Russian, 5 Western.

[215-6508]

RECONSTRUCTION OF SPATIAL STRUCTURE OF DAILY TIDES IN THE OCEAN USING LAPLACE TIDAL OPERATOR EIGENFUNCTIONS

Moscow OKEANOLOGIYA in Russian Vol 23, No 4, Jul-Aug 83 (manuscript received 15 Jun 82, after revision 27 Dec 82) pp 538-542

GOTLIB, V. Yu. and KAGAN, B. A., Leningrad Department, Institute of Oceanography imeni P. P. Shirshov, USSR Academy of Sciences

[Abstract] The spectrum of natural oscillations of the ocean includes resonant modes with frequencies close to the frequency of the daily tidal force harmonics. These loads are quite reminiscent of forced total oscillations. This indicates that the primary contribution to the formation of daily tides is made by resonant oscillations. Resonant oscillations from the diurnal frequency band can therefore be used as a suitable basis for restoration of the spatial structure of the daily tides in the ocean. This article confirms this conclusion. The restored fields of tidal level oscillations are used to estimate the dissipation of tidal energy in the world ocean. The mean dissipation of tidal energy per tidal cycle is  $2.50 \cdot 10^{11}$  for the  $K_1$  wave and  $1.16 \cdot 10^{11}$  for the  $O_1$  wave. The mean potential energy of these tidal waves per tidal cycle is  $10.53 \cdot 10^{15}$  and  $4.84 \cdot 10^{15}$  J, as opposed to  $9.3 \cdot 10^{15}$  and  $4.7 \cdot 10^{15}$  J in the static approximation. Figures 2; references 14: 3 Russian, 11 Western.

[213-6508]

UDC 551.465.553.001.57

## SEASONAL VARIABILITY OF INTEGRAL WIND CIRCULATION OF TYRRHENIAN SEA WATER

Moscow OKEANOLOGIYA in Russian Vol 23, No 4, Jul-Aug 83 (manuscript received 13 May 82; after revision 7 Sep 82) pp 543-550

MOSKALENKO, L. V., Southern Department, Institute of Oceanography imeni P. P. Shirshov, USSR Academy of Sciences, Gelendzhik

[Abstract] A theoretical model for a homogeneous, infinitely deep sea was studied to estimate the influence of seasonal variability of wind conditions over the Tyrrhenian Sea on total geostrophic circulation. The most rapid descent method was used to solve the basic equation for full water flow excited by the wind. In the winter the wind excites a single cyclonic circulation of water with two centers in the southwestern and southeastern portion of the sea. In the northern portion of the sea an anticyclonic circulation is formed. In the spring the single cyclonic circulation of the water breaks down into three independent centers and in the summer the high pressure trough reaches its maximum development. The primary axis of maximum wind extends from Sardinia to Sicily. In the fall the current restructures to the winter type of circulation, the anticyclonic circulation along the coast of Sardinia and Sicily becomes weaker. The Sardinian and Tunisian cyclonic vortices combine into a single cyclonic vortex. Maps of full flow functions and vortexing of wind shear stress are presented for the four seasons. It is noted that the circulation diagrams presented are not actually observed, but rather represent only the contribution of wind to the formation of the overall circulation of the water. Figures 2; references 5: 4 Russian, 1 Western.

[213-6508]

UDC 551.466.63

## GENERAL PROPERTIES OF NONLINEAR SYNOPTIC DYNAMICS IN SIMPLE BAROTROPIC OCEAN MODEL

Moscow OKEANOLOGIYA in Russian Vol 23, No 4, Jul-Aug 83 (manuscript received 31 Mar 82) pp 551-558

LARICHEV, V. D., Institute of Oceanography imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] The purpose of this work is to study the basic properties of solution of a nonlinear equation for a potential vortex for a barotropic ocean in the  $\beta$ -plane approximation. For clarity an ocean limited on the north by a zonal wall is analyzed. The evolution of potential vortex isolines is studied within the framework of this barotropic quasigeostrophic model. It is found that the amplitude of vortexing remains finite throughout time even in an unlimited area. The application of these results to Gulf Stream rings is discussed. Figures 3; references 14: 7 Russian, 7 Western.

[213-6508]

UDC 551.463

THEORY OF SHORT ROSSBY WAVES IN HOMOGENEOUS OCEAN

Moscow OKEANOLOGIYA in Russian Vol 23, No 4, Jul-Aug 83 (manuscript received 17 Jan 83) pp 559-565

LYSANOV, D. Yu., Institute of Oceanography imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] A study is made of the problem of the natural small amplitude of oscillations of a homogeneous incompressible fluid of constant depth covering the entire earth. The case of a homogeneous fluid studied in this article is a special case, and the frozen coefficient method normally applied to this type of problem will not work. Short-wave asymptotes of eigenfunctions and local dispersion relationships for the Rossby waves are constructed. Figures 2; references 7: 5 Russian, 2 Western.

[213-6508]

UDC 551.466.4

LABORATORY STUDY OF REGULAR GRAVITATIONAL-CAPILLARY WAVES IN CURRENTS

Moscow OKEANOLOGIYA in Russian Vol 23, No 4, Jul-Aug 83 (manuscript received 21 May 82) pp 575-583

POKAZEYEV, K. V. and ROZENBERG, A. D., Institute of Oceanography imeni P. P. Shirshov, USSR Academy of Sciences, Moscow State University imeni M. V. Lomonosov

[Abstract] A study is made of a low amplitude sine wave in the gravitational-capillary (intermediate) band from 2 to 11 Hz both in constant currents and in currents which are heterogeneous in the direction of wave propagation. The phenomenon of stopping and reflection or "blocking" of waves is ignored, as are nonlinear effects. Experiments were performed in a glass vessel 670 cm long, 50 cm high and 20 cm wide through which water flowed. Surface waves were created by a vibration type wave machine. A system of five electrode sensors at various distances from the wave generator was used to measure the height, periods, lengths and speeds of the waves. The data agree with the concept of linear wave theory. The specifics of gravitational-capillary waves in currents at speeds rather far from blocking indicate nontrivial variation of wave attenuation as a function of distance and velocity profile. Figures 6; references 8: 3 Russian, 5 Western.

[213-6508]

VARIATION IN MECHANICAL PROPERTIES OF SEA SURFACE CONTAMINATED WITH DIESEL FUEL AS FUNCTION OF ADDITION OF SURFACE-ACTIVE AGENTS

Moscow OKEANOLOGIYA in Russian Vol 23, No 4, Jul-Aug 83 (manuscript received 25 Sep 81, after revision 12 May 82) pp 584-587

PANKOV, V. M., ZOTOVA, K. V. and VORONINA, T. F., Murmansk Higher Marine Engineering School imeni Lenin's Komsomol

[Abstract] A study was performed of the mechanical properties of the interphase layers between diesel fuel and water in the process of aging as diesel fuel floats on the sea surface. Since petroleum products are now frequently manufactured with surface-active agents added, the influence of these agents on interphase viscosity was studied using oxyethylated fatty acids and proxanol, a block copolymer of propylene oxide and ethylene oxide as surfactant additives. Studies were performed on a twisting instrument using a disk pendulum immersed to half-thickness in water containing 3.5123% salt. The diesel fuel was then poured on top of the water to an indefinite thickness. Introduction of the surfactant changes the properties of the interphase boundary, yielding very low interphase viscosity. Upon long-term aging, the viscosity increases by four orders of magnitude. The surfactant molecules dissolved in the diesel fuel are adsorbed on the division interface, preventing the aging process of the interphase layer and retaining the low viscosity. Figure 1; references 8: Russian.

[213-6508]

SPECIFICS OF SEISMIC WAVE FIELDS AND STRUCTURE OF CENTRAL EAST INDIAN RIDGE CRUST

Moscow OKEANOLOGIYA in Russian Vol 23, No 4, Jul-Aug 83 (manuscript received 8 Sep 82) pp 616-621

NEPROCHNOVA, A. F. and SHISHKINA, N. A., Institute of Oceanography imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] This work analyzes kinematic and dynamic characteristics of seismic waves and refines models of the earth's crust for the East Indian Ridge in the region covered by the 58th cruise of the research vessel "Vityaz". The two areas covered, about  $4 \times 1^\circ$  each in size, are located on the top surface of the ridge and extend down its slopes. The crust is represented as a heterogeneous stratified medium with significant velocity changes at the boundaries of the layers and comparatively little change in velocity within layers. The curves of variation of velocity as a function of depth constructed by the Chibisov method fall within the limits of the band occupied by the models. The divergence observed between boundary velocities and the  $V(H)$  graphs computed by the model probably result from distortions arising when the Chibisov method is applied to a thick-layered model of the crust. Figures 4; references 7 (Russian).

[213-6508]

UDC 551.466

CALCULATION OF QUASIGEOSTROPHIC CURRENT FUNCTIONS BASED ON AUTOMATIC BUOY STATION MEASUREMENTS

Moscow OKEANOLOGIYA in Russian Vol 23, No 4, Jul-Aug 83 (manuscript received 24 Feb 82, after revision 20 Sep 82) pp 663-670

REZNIK, G. M., VINOGRADOVA, K. G., Institute of Oceanography imeni P. P. Shirshov, USSR Academy of Sciences, Moscow

[Abstract] A simple method is suggested for calculating the quasigeostrophic current function at a fixed measurement level at the nodes of a regular grid. The method requires no information concerning the statistical characteristics of the processes being measured. The only requirement is that the synoptic component be removed from the measurement data, i.e., the initial time series should not contain oscillations with periods of less than several days. The quasigeostrophic velocity fields used in the article were obtained in the POLYMODE experiment as a result of filtration of the initial time series with a filter with a period of four days. The algorithm developed was implemented as a Fortran program. Qualitative agreement is achieved between isolines constructed by the method suggested and by the objective analysis method.

Figures 7; references 1: (Russian).

[213-6508]

UDC 551.465.15(265)

CAPABILITIES OF BAYES METHODS IN PROCESSING HYDROPHYSICAL MEASUREMENTS

Moscow OKEANOLOGIYA in Russian Vol 23, No 4, Jul-Aug 83 (manuscript received 30 Sep 81) pp 671-676

POZDYNIN, V. D., Institute of Oceanography imeni P. P. Shirshov, USSR Academy of Sciences

[Abstract] One of the most important results of processing of materials by Bayes methods is the generation of so-called prognostic functions of the distribution of the random quantity studied. This article illustrates this capability of Bayes methods using results of processing of materials from measurement of characteristics of small-scale turbulence and Richardson numbers at an equatorial test area in the central Pacific in February-March, 1980. The a posteriori distributions and prediction functions generated can be used in later studies as a priori information. It is noted that in areas of the ocean with current structures less dynamic than at the equator, the binomial model used to describe the development of turbulent disturbances can be replaced by a probabilistic model based on the Poisson distribution, allowing estimation of the probability of development of turbulent disturbances considering changes in the intensity of the process in time and space. Figures 3; references 8 (Russian).

[213-6508]

UDC 551.463

VERTICAL INTERPOLATION OF HYDROPHYSICAL PARAMETERS BY RATIONAL SPLINES

Moscow OKEANOLOGIYA in Russian Vol 23, No 4, Jul-Aug 83 (manuscript received 26 Nov 82) pp 677-680

BELKIN, I. M., Institute of Oceanography imeni P. P. Shirshov, USSR Academy of Sciences

[Abstract] The problem of vertical interpolation in oceanography is a pressing one, requiring improved, new methods and modern computers. Cubic splines were first used for this purpose, yielding high accuracy of smooth functions continuous in first and second derivatives. However, cubic splines may generate oscillations near points of sudden change of the function being interpolated. More complex spline functions such as rational splines can be used to eliminate this problem. This work describes an algorithm for automatic selection of parameters intended for vertical interpolation in oceanography, particularly for processing of data from bathometric stations. The algorithm produced is implemented as a Fortran program. Figures 2; references 9: 8 Russian, 1 Western.

[213-6508]

UDC 551.463

SPECIFICS OF APPLICATION OF NONLINEAR FAN FILTRATION METHODS TO PROCESSING OF DEEP SEISMIC SOUNDING AND CONTINUOUS SEISMIC PROFILE METHOD DATA

Moscow OKEANOLOGIYA in Russian Vol 23, No 4, Jul-Aug 83 (manuscript received 1 Dec 82) pp 688-693

CHERKHUTSKIY, G. A., Southern Division, Institute of Oceanography imeni P. P. Shirshov, USSR Academy of Sciences, Gelendzhik

[Abstract] The application of nonlinear filtration to continuous seismic profile and deep seismic sounding data involves a number of difficulties related both to the characteristics of the data and the processing algorithms. The characteristics of lobes of the directionality characteristic lead to ambiguous interpretation of processing results and the appearance of additional background noise. This is analyzed in the example of processing of deep seismic soundings data by the regulated directed reception method. The capabilities of a nonlinear fan filter based on the use of weighted functions to predict the existence of a regular wave outside the processing based are studied. The work was performed on a Yes-1010 minicomputer at the "Yuzhmorgeologiya" Association. Before and after examples of wave recordings processed by the method are presented. Figures 3; references 6 (Russian).

[213-6508]

UDC 551.466

MEASUREMENT OF SURFACE WAVE ACTION BY MULTIPLE-ELECTRODE INSTALLATION FROM MOVING SHIP

Moscow OKEANOLOGIYA in Russian Vol 23, No 4, Jul-Aug 83 (manuscript received 19 Dec 81, after revision 24 May 82) pp 704-711

SHAUB, Yu. B., DEMENOK, V. N. and SHCHETININ, A. A., Pacific Ocean Institute of Oceanography, USSR Academy of Sciences, Far Eastern Scientific Center, Vladivostok

[Abstract] A study is made of the specific capabilities of multiple-electrode installations for measurement of surface wave action when towed from a ship. The extreme simplicity of the transducers used in such installations, consisting of a cable with several electrodes with no electromechanical or electronic devices requiring sealed containers, allows them to be towed at full speed by practically any ship. The theoretical foundation of the method, which uses a sine wave 1200 Hz voltage generator and three independent but identical channels for amplification and conversion of the working signals, is presented. The results of field experiments are reported. Studies were performed for the first time in the spring of 1981 in the South China Sea. With properly selected speed (about 11 knots) with the cable submerged to about 3 m depth, clear recordings were obtained, revealing even small surface waves. The experiments thus demonstrate a genuine possibility for measurement of even small-scale surface waves by means of towed electrical sensors at normal ship movement speeds. Figures 6; references 8: (Russian).

[213-6508]

UDC 551.466

OVERSHOT EFFECT IN DEVELOPING WIND WAVE SPECTRUM

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 270, No 6, Jun 83 (manuscript received 6 Dec 82) pp 1474-1478

LEYKIN, I. A., POKAZEYEV, K. V. and ROZENBERG, A. D., Institute of Oceanography imeni P. P. Shirshov, USSR Academy of Sciences, Moscow; Moscow State University imeni M. V. Lomonosov

[Abstract] Results are discussed from measurement of wind waves developing in a laboratory channel, and a universal growth curve is suggested considering separation of the frequency of the component being studied from the frequency of the spectral maximum with an increase in acceleration. It is also shown that the oscillating nature of the growth curve under saturation conditions results from nonlinearity of the waves. Measurements were performed at Moscow State University in a wind channel with a length of 25 m, width 1.25 m and height 3 m. The water level during the measurements was H=0.7 m. Nichrome wire resistance sensors were used to measure wind-driven wave action. Experiments were performed by recording wave action at 15 points with constant wind

speed and stable wave action allowing the variation of wave parameters as a function of fetch to be studied over fetch range of 1.5 to 15.5 m. The experiments were accompanied by measurement of the vertical profile of mean air speed at 3 points along the length of the channel to determine the dynamic flow speed. Oscillating changes in spectral density under saturation conditions were found to be related to nonlinearity of waves appearing when harmonics were present in the spectra. This convincingly confirms the existence of a universal growth curve for waves. Figures 3; references 11: 4 Russian, 7 Western.

[9-6508]

UDC 551.464:553.3

#### IRON-MANGANESE NODULES - SEDIMENTATION-DIAGENETIC FORMATIONS (PHYSICAL-CHEMICAL ANALYSIS)

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 270, No 6, Jun 83  
(manuscript received 20 Dec 82) pp 1471-1474

GRAMM-OSIPOV, L. M., BYCHKOV, A. S., VOLKOVA, T. I., TISHCHENKO, P. Ya., and SHUL'GA, Yu. M., Pacific Ocean Institute of Oceanography, Far Eastern Scientific Center, USSR Academy of Sciences, Vladivostok

[Abstract] An attempt is made to answer the question of the origin of the primary nodule-forming minerals in iron-manganese nodules, based on the apparatus of equilibrium thermodynamics. The solid phase for which calculations were performed to answer the question of the possibility of precipitation of manganese from sea water was  $\delta$ -MnO<sub>2</sub>. The calculations showed that sea water is supersaturated with  $\delta$ -MnO<sub>2</sub> at T=298.15°K and P=1.013·10<sup>5</sup> Pa. The question of the participation of microorganisms in the oxidation of Mn (II) to Mn (IV) is discussed. The established supersaturation, as well as the diagenetic redistribution of manganese in oxidized pelagic sediments, indicates a sedimentation-diagenetic mechanism of formation of the nodules. The nodules in deep parts of the ocean in which Mn predominates over Fe have a sedimentation-diagenetic nature due to the additional flux of manganese from the sediments below. The slow formation of the nodules is explained by the low kinetics of oxidation of Mn (II) to Mn (IV). The role of microbiological oxidation in the formation of oceanic ores is therefore much less significant than in lakes.

Figures 1; references 14: 9 Russian, 5 Western.

[9-6508]

## TERRESTRIAL GEOPHYSICS

### WORK OF S. FEDOTOV ON EARTHQUAKE FORECASTING

Moscow IZVESTIYA in Russian 10 Aug 83 p 3

[Article by A. Ivakhnov: "Earthquakes: Progress towards Forecasting"]

[Text] In the middle of the 1960's, the Soviet scientist S. Fedotov proposed an original method for predicting the location of strong earthquakes in the Pacific coast area of our country.

Utilization of this method led him to the conclusion that the next powerful underground shocks would occur on the Japanese island Hokkaido, our Shikotan island and at some other locations in the Kuril-Kamchatka arc. In the following years powerful earthquakes occurred precisely where the then young seismologist had indicated. Today his method is applied by scientists in the USA, Mexico, Japan and other countries. S. Fedotov, Corresponding Member of the Academy of Sciences USSR, is now the director of the Volcanology Institute of the Far Eastern Scientific Center.

The scientist spreads out on the table a map of the Pacific coast on which a certain area is crosshatched. This is the zone in which earthquakes occur. These shocks are numerous and powerful not only in the Far East but also all over the world. One boundary to the zone runs through the Kuril-Kamchatka trough while another runs along the continental shelf. Ovals are marked in the crosshatched zone indicating regions where underground shocks have occurred in recent centuries.

"These five earthquakes," says Sergey Aleksandrovich, "were predicted and occurred in the period 1965-1983. But here are sections where there are no ovals at the present time. And yet these are precisely the areas which are especially dangerous. There are many reasons for supposing this."

While tracing the development of seismicity at the foci of powerful shocks, I noticed that the strongest quakes in one place, the Kuril-Kamchatka arc, did not reoccur for periods of one to two hundred years. For a period of approximately fifteen years after strong shocks a process of fading of seismic activity occurs and it then becomes quite low-level and constant. Then after fifteen years, activity begins to increase until there is another powerful shock. On the basis of these observations, I concluded as to the regularity of the behavior of the Far Eastern earthquakes and discovered the characteristics of the seismic cycle.

But why should the most powerful underground shocks in different areas of the Kuril-Kamchatka arc repeat themselves after identical periods of time? How are the stresses in the depths of the earth accumulated and then discharged? At the present time, the physics of this phenomenon is not completely clear. In any case, it is known that in the seismic zone we are talking about, the oceanic plate is plunging underneath the continental plate. In the process of movement, the edge of the continental plate is constantly descending. Thus there is stress at the boundary of the plate which, at one location or another, reaches the critical level and powerful faulting occurs. A section of the margin then straightens out and at the surface there are strong earthquakes.

Data exist indicating that seismic activity is linked in a definite way to the position of the moon relative to the earth. As a result of a change in the inclination of the lunar orbit, tides are particularly reinforced and this occurs not only in seas and oceans but also within the earth's dry land surface. Scientists superimposed plots of strong shocks on cycles of lunar orbital changes (for a total period of 18.6 years) and observed that, for certain parts of this period, the number of subterranean shocks in Kamchatka and the Kuril islands was especially great, while for others the number was minimal. There are thus reasons to suppose that lunar tides might be "trigger mechanisms" for subterranean shocks."

One of the basic tasks of the institute, of which Sergey Aleksandrovich is the head, consists in forecasting earthquakes and, insofar as possible, in reducing the risks of these events.

"The work is carried out in different directions," continued the scientist. "A map of the country's seismic regions to be used for determining structural standards and rules was compiled. The map shows the areas in which quakes occur and the maximum intensities in each case. Research was carried out on seismic micro-regionalization. It is known that in the same quake people may sleep peacefully in buildings with solid rock foundations while, at the same time, in areas of loose water-saturated rock debris, where shocks are especially perceptible, delapidated structures are damaged. Our objective is to aid constructors to select optimal types of building construction which will be very safe but not too expensive. This, if we can apply hydrometeorological terms, relates to the "climate" of the subterranean depths. If we can speak of 'weather' in this sense, then we find that long-range forecasts are justified in 80% of the cases. Many precursors of earthquakes are studied such as electrical anomalies, changes in flow and chemical composition in groundwater, magnetic field variations, deformations of the earth's surface, etc. We do have seismic stations, but, at the present time, there are not enough of them to make possible an exhaustive map of subterranean processes. However their number is increasing, and by the end of the century, we hope, the service for the observation of these processes will be as developed as present-day weather services as concerns size and the use of the newest technology. Seismic forecasting will then be even more precise."

12497  
CSO: 1865/210

UDC 550.311:551.241

## SPREADING MECHANISM IN ACTIVE BOUNDARY SEAS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 271, No 5, Aug 83  
(manuscript received 30 Jul 82) pp 1101-1103

MONIN, A. S., corresponding member, USSR Academy of Sciences, and SOROKHTIN, O. G.,  
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Moscow

[Abstract] Boundary seas, basins separated from the ocean by a zone of subduction with a corresponding island arc, may be active, having an internal spreading zone. Local spreading in an area of regional compression is paradoxical but has obviously occurred in the past. It has been thought that spreading is created by relief of horizontal compression or subduction in advance of the island arcs. The authors believe that the large mantle diapirs which arise beyond the island arcs are results of spreading. Diagrams of the process are presented and explained. Figure 1; references 8: 1 Russian, 7 Western.

[3-6508]

UDC 550.372

## ELECTRET EFFECT UPON FRACTURE OF ROCK

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 8, Aug 83  
(manuscript received 23 Feb 82) pp 104-108

BALBACHAN, M. Ya. and PARKHOMENKO, E. I., USSR Academy of Sciences, Institute of Earth Physics imeni O. Yu. Shmidt

[Abstract] Previous studies have established an electret effect arising upon electrification of rock specimens by friction under laboratory conditions. The next stage was to determine whether a similar phenomenon occurs upon fracture of rock. Specimens of white fine-grained marble, peridotite, basalt and polymethylmethacrylate were studied in the shape of rectangular parallelpipeds measuring 20 x 20 x 40 mm, 10 x 10 x 20 mm for the peridotite. Notches 1 mm

deep were cut along the bottom and sides of the specimen to assure that they would fracture in the desired plane. Specimens dried and neutralized to eliminate the electric charge were installed on two grounded steel mounts and broken by a curved steel indentor which produced tensile stresses by bending the specimen. This eliminated the possibility of friction between the newly formed surfaces. The effective charge of each face of both portions of the specimen after fracture was determined. The distribution of charge over the faces was measured. A positive charge was found to develop on all of the new fracture surfaces. Relaxation polarization causes a negative effective charge on newly developed surfaces and a positive effective charge on the rear and side surfaces. Some of the electrons emitted are captured by traps on the newly formed surfaces, partially compensating the positive charge. Ionization of the air near the back and side surfaces and capture of electrons by traps on these faces causes a coupled negative charge to develop. In the geophysical interpretation it is important to note that as rock fractures, the charges are separated. The fractured rock is charged positively, the gas and water filling the cracks negatively. Fracture and friction thus may both play an important role in the formation of the electric precursors of earthquakes. Figures 5; references 9: 8 Russian, 1 Western.

[216-6508]

UDC 550.312

#### SPECTRAL ANALYSIS OF NORTH ATLANTIC GRAVITATIONAL FIELD

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 8, Aug 83  
(manuscript received 10 Jun 82) pp 39-48

ARTEM'YEV, M. Ye., BABAYEVA, T. M., BUGAYEVSKIY, A. G. and VOYDETSKIY, I. Ye.,  
USSR Academy of Sciences, Institute of Earth Physics imeni O. Yu. Shmidt

[Abstract] A study is made of the possibility of applying a method developed earlier by the authors for determining the contribution of various classes of anomaly-forming factors in an observed gravitational field to oceanic regions in the example of the northern half of the Atlantic Ocean. The initial data are free-air anomalies averaged over  $1 \times 1^\circ$  trapezoids in the North Atlantic and adjacent continental regions. Spectral analysis of data on the topography of the earth, isostatic and free air anomalies indicates that the isostatic anomalies are the most convenient means for representing gravimetric data for the study of density heterogeneities in the mantle and determination of the mantle and lithosphere components of the gravitational field. The major factor which makes free air anomalies less suitable for solution of the problem is the presence of a long-wave component resulting from regional variations in the elevations of topographic relief and the thickness of the crust. The results indicate that the model of distribution of anomaly-forming objects in the earth based on physical assumptions does not contradict the observed field regularities. The long-wave portion of the spectrum of isostatic anomalies indicates that there are large deep heterogeneities in the mantle, the spatial distribution of which is not visibly correlated to the topography of the earth's surface, structure of the crust or nature of tectonic activity. Figures 5; references 20: 12 Russian, 8 Western.

[216-6508]

UDC 550.348.098.64

STATISTICAL ANALYSIS OF EARTHQUAKE SEQUENCES IN FAR EAST AND CENTRAL ASIA

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 8, Aug 83  
(manuscript received 5 May 82) pp. 20-29

ODINETS, M. G., USSR Academy of Sciences, Institute of Oceanography

[Abstract] A. M. Shurygin has suggested a point flow model based on standard densities called a homogeneous flow. Such a flow is called a homogeneous sequence for the 1-dimensional case in which the sequence varies only as a function of time. This statistical model is applied to analysis of sequences of Far Eastern and Central Asian earthquakes. It is found that the time correlations among deep-focus and normal earthquakes differ significantly, indicating that the seismogenic processes in the two cases are different. A cycle with a period of 5.5 years in resonance with the solar cycle is characteristic for normal earthquakes in the Far East. In Central Asia the same cycle is observed, though less clearly and shifted in phase. Figures 3; references 10 (Russian).

[216-6508]

UDC 550.348.2

STRONG EARTHQUAKES OF 1974-1975 IN SOUTHERN KURIL ISLAND CHAIN. FOCAL PROCESSES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 8, Aug 83  
(manuscript received 13 Jan 83) pp 3-19

BALAKINA, L. M., USSR Academy of Sciences, Institute of Earth Physics imeni O. Yu. Schmidt

[Abstract] The purpose of this work was to establish the peculiarities of seismogenic tectonic movements in the lithosphere in the Southern Kuril Island chain by studying the mechanism of the epicenters of several large earthquakes. Specifics of development of faults at the epicenters of these earthquakes were also determined. A group of earthquakes with magnitude around 7 which developed in the lithosphere of the region in late 1974 and mid-1975 are studied. They include the earthquakes of 27 September and 9 October 1974 and a group of shocks in June 1975 beginning with the tsunami-generating earthquakes of 10 June. This quake was followed by four shocks with magnitude of 6.7-7.2 and a long series of weaker aftershocks. A map of the epicenters and sample seismic recordings are presented. The strong earthquakes of June 1975 as well as the earthquake of 27 September 1974 resulted from upthrust of blocks along steep faults extending in a north-northeast direction. The quake of 9 October 1974 was caused by a longitudinally oriented upthrust. This agrees well with the morphology of the island slope of the trough which features upthrust steps. The seismogenic motions along the faults in blocks along the lithosphere in

this area are thus more complex than the simplified scheme of successive propagation of shear movements in a continuous and homogeneous elastic space. The P-wave velocity is reduced in the focal zone of the Southern Kuril Island arc in comparison to the surrounding mantle. Figures 6; references 20: 16 Russian, 4 Western.  
[216-6508]

UDC 550.834

DETERMINATION OF POWER SPECTRA OF WAVES SCATTERED BY SMALL AND LARGE SCALE HETEROGENEITIES OF MEDIUM BASED ON SEISMIC PROSPECTING MATERIALS

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA B: GEOLOGICHESKIYE, KHIMICHESKIYE I BIOLOGICHESKIYE NAUKI in Russian No 7, Jul 83  
(manuscript received 5 Feb 82) pp 20-23

KARPENKO, I. V. and KARPENKO, S. G., Kiev Geophysical Department, Ukrainian Scientific Research and Geological Prospecting Institute

[Abstract] If an elementary seismic signal is a minimal phase signal, only its power spectrum is required to construct the operators of optimal filters. Determination of the power spectrum from a single actualization requires a recorded length at least 100 times the length of the elementary signal. Averaging of spectra over several lines of recording devices is no more helpful than recording from a single line in production of this information. This article demonstrates that the condition of nondependence of information on signal components is satisfied by an actualization containing only the set of elementary wave signals scattered by deep discontinuities in the seismic medium. The algorithms developed in the article can be used to design the optimum filters to predict the structure of the geological cross section on the basis of seismic data. Reference 1 (Russian).

[211-6508]

UDC 552.08

SEISMIC WAVE VELOCITY AND DENSITY OF MATTER IN MANTLE BENEATH CRUST IN OCEAN TRENCH

Kiev DOKLADY AKADEMII NAUK UKRAINSKOY SSR, SERIYA B: GEOLOGICHESKIYE, KHIMICHESKIYE I BIOLOGICHESKIYE NAUKI in Russian No 7, Jul 83  
(manuscript received 31 Mar 83) pp 10-13

GORDIYENKO, V. V., Institute of Geophysics, Ukrainian Academy of Sciences

[Abstract] Recent studies of the upper mantle by seismic and gravimetric methods have revealed zones with anomalous P-wave velocity ( $V_p$ ) and densities ( $\sigma$ ) in some regions of the continents directly beneath the crust. The regions

in question are tectonically quite varied, combined by a single element of geological history: the last active event was primary magmatism of mantle origin. The changes should be strongest in areas where magmatism has been particularly strong, doubtlessly including oceanic areas. Seismic wave velocities in the portion of the mantle beneath the crust in an ocean trench should be significantly higher than in the basement beneath the Precambrian platform, in spite of the higher temperature. The difference should reach 0.3 to 0.4 km/s, and can be recorded in seismic studies of sufficient depth. However, these increased speeds may not be reflected in the boundary velocity at the Moho discontinuity due to the low velocity interval immediately beneath the crust. Differences in the density of rocks of the upper mantle in these regions should lead to a drop in mantle gravitational effect of about 0.8-1.0 mm/s<sup>2</sup>. References 9: (Russian).

[211-6508]

UDC 551.24.035

#### STUDYING TECTONIC STRESSES FROM FIELD OBSERVATIONS OF GLIDE PLANES AND STRIAE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 272, No 5, Oct 83  
(manuscript received 21 Apr 83) pp 1103-1107

SHISHKIN, Ye. I. and YUNGA, S. L., Institute of Physics of Earth imeni O. Yu. Shmidt, USSR Academy of Sciences, Moscow

[Abstract] The authors demonstrate the possibility of reconstructuring a uniform generalized plane stressed state by means of analysis of measurements of glide planes and striae. The latter are traces of movements and are expressed on the glide plane. The finding of the trajectories of the vectors of shearing stresses on the glide planes gives a solution of the direct problem of orientation of the striae. A determination of the parameters of stressed state on the basis of orientation of the glide planes and striae is the inverse problem. In order to formulate and solve the problem it is necessary to select the scale level in such a way that a geological object with the characteristic dimension L and the fractures  $\sim \ell$  can be considered a continuous medium. Then the tensor of tectonic stresses is

$$\langle \sigma_{ij} \rangle = \lim_{l/L \rightarrow 0} \frac{1}{V} \left[ \int_S \frac{1}{2} (P_i x_j + P_j x_i) dS + \int_V \frac{1}{2} (f_i x_j + f_j x_i) dV \right], \quad (1)$$

where  $P_i$ ,  $i = 1, 2, 3$  is the vector of the surface force related to a unit area at some point  $x_i$  of the surface  $S$  of the region  $V \sim L^3$ ,  $f_i$  is the vector of the force related to a unit volume. The authors examine the case of formation of fractures in a horizontal layer of rocks in a uniform generalized stressed state

$$\langle \sigma_{12} \rangle = \langle \sigma_{23} \rangle = 0, \quad \langle \sigma_{13} \rangle = \langle \sigma_{31} \rangle = 0. \quad (2)$$

The glide planes are stipulated by the normals  $n_i^{\eta}$ ,  $\eta = 1, 2, \dots, N$ , the orientation of the striae is stipulated by the axial unit vectors  $v_i^{\eta}$ ,  $\eta = 1, 2, \dots, N$ ;  $\eta$  is the number of the observation and  $N$  is the total number of observations. The mechanism of volumetric deformation is described in accordance with the Reuss hypothesis. The striae are assumed to be parallel to the shearing stress vectors in the corresponding areas. In each case the scalar product of the vectors  $n_i^{\eta}$ ,  $v_i^{\eta}$  and the shearing stress is equal to 0, that is

$$e_{klm} n_l^{\eta} v_k^{\eta} n_i^{\eta} \langle \sigma_{mi} \rangle = 0, \quad \eta = 1, 2, \dots, N, \quad (3)$$

where  $e_{klm}$  are Levi-Civita symbols. Then the first and second invariants of the tensor  $\langle \sigma_{ij} \rangle$  (not exerting an influence on orientation of the shearing stress vectors) are registered

$$\langle \sigma_{ii} \rangle = 0, \quad \frac{1}{2} \langle \sigma_{ij} \rangle \langle \sigma_{ji} \rangle = 1. \quad (4)$$

In a correct formulation the inverse problem involves solution of a system  $N$  homogeneous linear equations (3) relative to the  $\langle \sigma_{ij} \rangle$  components under conditions (2), (4) in the sense of the minimum of the sum of the squares of its equations. Proceeding on this basis, the analytical and numerical methods for solving the problem are examined and the results are interpreted. Figures 3; references 15: 14 Russian, 1 Western.

[17-5303]

UDC 525.2

## POSSIBLE MECHANISM OF MOVEMENT OF EARTH'S MASSES

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 272, No 5, Oct 83  
(manuscript received 3 Jun 83) pp 1097-1099

BOBRYAKOV, A. P., REVUZHENKO, A. F. and SHEMYAKIN, Ye. I., corresponding member USSR Academy of Sciences, Mining Institute, Siberian Division, USSR Academy of Sciences, Novosibirsk

[Abstract] Data have been published indicating that the earth's reactions to tidal deformations differs from ideally elastic. Therefore the authors have examined a model of the process making it possible to discriminate some effects of the inelastic reaction. The problem is reduced to periodic loading under conditions when the configuration of the surface bounding the inelastic body remains unchanged. The principal results are illustrated in a plane model. In the experiments an inelastic body was placed in a shell—a straight vertical cylinder of an approximately elliptical cross section with axes of 121.5 and 110.5 mm and a height of 180 mm; this cylinder was fabricated of sheet bronze so that its cross-sectional configuration could change. The bottom was covered with rubber and the cylinder was set on a smooth horizontal disk. The loading device was a straight rigid cylinder into whose internal cavity the shell with the deformable body fitted precisely. The load was applied by rotating the rigid cylinder in a counterclockwise direction at a rate of 0.2 rad/sec. Since the cross-sectional configuration was not circular, rotation resulted in periodic deformation of the body placed in the fixed shell. The inelastic body used was dry quartz sand with a particle size 0.3 mm. A series of photographs illustrates the results of this modeling. It was found that changes in scale of the model, type of loose material, eccentricity to some critical value and rate of loading exerted no influence on the qualitative picture of deformation. The modeling results clearly suggest that periodic tidal deformations can result in a directed transfer of the earth's masses and its fluid core. Transfer of this type can be one of the reasons for appearance of the earth's magnetic field, migration of the poles and global tectonic processes. Figures 4; references: 3 Russian.

[17-5303]

UDC 550.344

## IRREGULAR SEISMIC WAVES AND CHARACTERISTICS OF ASTHENOSPHERE BENEATH OCEANS AND CONTINENTS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 272, No 6, Oct 83  
(manuscript received 10 May 83) pp 1355-1358

KOPNICHEV, Yu. F., Institute of Physics of Earth imeni O. Yu. Shmidt, USSR Academy of Sciences, Moscow

[Abstract] The parameters of irregular waves are used in evaluating absorption in the upper mantle. A study of coda characteristics involved an analysis of seismograms in the intermediate zone of epicentral distances ( $200 \text{ km} < A < 2,00 \text{ km}$ ).

The seismograms can be divided into three sharply differing groups: 1) records with a dominance of the Lg "channel" phase; 2) records whose envelopes show two distinct phases commensurable in energy with the direct P-waves; 3) records on which these phases are far less intense than the direct P-wave. The polarization characteristics were investigated for obtaining additional information on the two mentioned phases; these data are interpreted. The nature of the differences in the wave pattern are examined for the three mentioned groups. The analyzed data indicate that the asthenosphere is most strongly expressed under the oceans (especially the Pacific and Indian Oceans) and some (Mediterranean, Red) seas. This applies in particular to the anomalous mantle, the asthenospheric layer with a relatively high temperature and a sharply reduced viscosity playing a highly important role in the development of tectonic processes. In tectonically active regions on the continents absorption in the upper mantle is usually far weaker than in the considered ocean regions. There is good basis for concluding that under many internal regions of the oceans the asthenosphere is expressed considerably more strongly than under the continents. It is postulated that in most cases the anomalous mantle flows from beneath the oceans under the continents. With increasing distance from the mid-oceanic ridges, where heated matter possibly rises to the bottom of the lithosphere, the anomalous mantle increasingly cools, resulting in a decrease in absorption and a regular change in structure of the wave field. Presumably one of the main reasons for disappearance of the Lg phase on the records of the first and second groups is an increase in absorption in the crust caused by increased heat flow from the mantle. Figures 2; references 13: 10 Russian, 3 Western.

[19-5303]

UDC 551.242:553.981/982(571.1)

#### REGIONAL TECTONIC RESTRUCTURING AND GAS CONTENT OF WESTERN SIBERIA

Moscow GEOTEKTONIKA in Russian No 5, Sep-Oct 83 (manuscript received 18 Jan 81)  
pp 67-73

NAUMOVA, A. L., ONISHCHUK, T. M., DYADYUK, N. P., IVASHCHENKO, A. Ye.,  
KIRGINTSEVA, G. A. and ROMANENKOV, V. A., Tyumen' Thematic Expedition

[Abstract] Recently a new method of tectonic research has appeared, correlation analysis of thicknesses. It can be used to reliably distinguish regions whose tectonics differ from the inherited tectonic development of the region. These include territories experiencing uplift at a young age. The essence of the method is described. A schematic map of regional tectonic restructurings in Western Siberia is presented. The results of the correlation analysis indicate that the gas-bearing regions of Western Siberia are in zones of young tectonic restructuring, territories which have experienced elevation in post-Senonian time. Gas deposits are younger than petroleum deposits, which correlate with the nature of oil and gas fields. In Northwestern Siberia in addition to the primarily gas-bearing territory there are also potential oil-bearing regions. The method suggested for studying regional tectonics utilizing easily accessible and easily verified initial geological parameters can in some cases yield reliable conclusions of theoretical and practical significance.

Figures 4; references 15: (Russian).

[15-6508]

UDC 50.831.01

## SOME RESULTS OF THE STUDY OF NONTIDAL CHANGES IN GRAVITY

Moscow GEOTEKTONIKA in Russian No 5, Sep-Oct 83 (manuscript received 28 Aug 82)  
pp 8-19

BULANZHE, Yu. D., Institute of Physics imeni O. Yu. Shmidt, USSR Academy of Sciences

[Abstract] This literature review covers the results of studies of secular changes in gravity from 1935 to the present in the Soviet and Western literature. The study of the change in the earth's gravitational field with time is of great significance for many areas of natural science such as physics, celestial mechanics, astrometry, geodesy, geology and geophysics. The problem was found to be a complex one, and as yet no reliable data are available on global changes due to the insufficient number and duration of observational series. Theoretical estimates give reason to believe that if there are global changes in gravity they are small, not over 5 to 10  $\mu$ gal per year. Changes in gravity of a quasiperiodic nature with periods on the order of 7 to 8 years and amplitudes of about 20  $\mu$ gal have been discovered at certain points. Relative measurements of gravity performed in Eastern Europe have established that the changes with time are less than the error of their determination. Between 1969 and 1977 gravity increased by  $44+4$   $\mu$ gal at Sevres, possibly a result of a change in the hydrologic conditions near the observatory. The fact of local and regional changes in gravity of a few tens of  $\mu$ gal per year has been established. References 38: 12 Russian, 26 Western.

[15-6508]

UDC 550.362:552.1:53

## CRUSTAL TEMPERATURE FIELD WITHIN THE USSR

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 270, No 6, Jun 83  
(manuscript received 13 Dec 82) pp 1431-1434

MOISEYENKO, U. I., All-Union Scientific Research Geological Institute imeni A. P. Karpinskiy, Leningrad

[Abstract] Measured values of heat flux density were used to calculate deep temperatures and construct temperature cross section maps for various depths. The reliability of the calculations was evaluated qualitatively by comparison with the results of other methods, quantitatively by comparison with the data from temperature measurements in boreholes. At a depth of 20 km the highest temperature values of 800 to 1000°C are characteristic for areas of active Cenozoic development. Low temperatures down to 200°C were found in the northwestern Ukrainian shield, southern Urals and Salair. Temperatures of 600 to 800°C were calculated for the northwestern portion of the western Siberian platform, Verkhoyan', and the Yano-kolyma folded system. Temperature anomalies increase with increasing depth, change their form and direction. The temperature at the Moho discontinuity varies from 300°C to 1100-1150°C. Figures 2; references 6 (Russian).

[0-6508]

UDC 525.622

MANIFESTATION OF RESONANCE EFFECTS OF LIQUID CORE OF EARTH IN TIDAL DEFORMATIONS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 272, No 3, Sep 83  
(manuscript received 15 Apr 83) pp 578-582

LATYNINA, L. A., Institute of Earth Physics imeni O. Yu. Shmidt, USSR Academy of Sciences, Moscow

[Abstract] Theoretical studies have established the existence of free diurnal nutation with a period of approximately 23.88 hours, established the disturbance of forced nutations and harmonics in the terrestrial tides at near-resonant frequencies. Tidal variations in gravity, as well as slopes and deformations of the terrestrial surface, are proportional to a combination of the Love numbers  $h$  and  $k$  and the Shied number  $l$ , which reflect the properties of the earth. Data on tidal deformation of the earth were used to study the structure of the earth. This article demonstrates that these same data can be used to study the resonant effects of the earth's core. Errors which must be considered to eliminate disagreements between experimental and calculated values are analyzed. The remaining disagreement can be eliminated by decreasing the resonant parameter  $\beta$  in the M. Sm Moledenskiy theory by 12%. The parameter  $\beta$  defines the variation of  $h$ ,  $k$  and  $l$  as a function of frequency. Data on tidal deformations may make it possible to obtain more detailed information on the interaction of the core and shell of the earth, which would require more precise elimination of indirect tidal effects from the observations. References 12: 9 Russian, 3 Western.

[12-6508]

UDC 550.311

NEW GEODYNAMIC MODEL

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 272, No 3, Sep 83  
(manuscript received 4 Apr 83) pp 575-578

KROPOTKIN, P. N., corresponding member, USSR Academy of Sciences, Institute of Geology, USSR Academy of Sciences, Moscow

[Abstract] A new geodynamic model is suggested in which the movement of lithospheric plates results not from a difference in geostatic pressure on equipotential surfaces of the earth's gravitational field, as was assumed in the convection hypotheses, but rather variations in the earth's radius. As the earth expands the sides of rift zones spread and material moves inward forming the oceanic crust. This increase in the surface of the earth is compensated during the compression phase by subduction of the edges of the plates. In general the model is reminiscent of the mechanism of rotation of a ratchet. Variations in the speed of rotation of the earth, the total energy of earthquakes, amplitudes and periods of Chandler oscillations, magnetic field intensity and mantle slip rates over the magnetic core of the earth all have a common cause, probably fluctuations in the gravitational constant  $G$ . References 15: 14 Russian, 1 Western.

PHYSICS OF ATMOSPHERE

UDC 550.388.2

POSSIBLE CAUSE OF TERRESTRIAL EXCITATION OF IONOSPHERIC D AREA

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 271, No 5, Aug 83  
(manuscript received 4 Oct 82) pp 1103-1107

RAPOPORT, Z. Ts., Institute of Terrestrial Magnetism, the Ionosphere and Propagation of Radio Waves, USSR Academy of Sciences, Troitsk, Moscow Oblast

[Abstract] It has been established that the increase in absorption in the D area in winter results from an increase in electron concentration primarily at altitudes of 70 to 90 km. Based on data obtained in January of 1981, a study is made of the picture of global circulation to estimate the effectiveness of the horizontal transfer in increasing the density of NO in the mesosphere. It is assumed that the circulation picture observed occurs not only at 60 km altitude, but also throughout the higher altitudes. It is concluded that movement of dry air rich in nitrogen oxides from the auroral zone to the middle latitudes creates an elevated concentration of nitrous oxide and reduced density of hydrated ions in the middle latitudes. This means that the position and intensity of the circumpolar vortex, together with variations in the intensity of the flux of particles in the auroral zone, are the reasons for both regular and excessive winter absorption. Figures 3; references 11: 1 Russian, 10 Western.

[3-6508]

UDC 551.508.91:551.521.3

INFLUENCE OF MODULATED ELECTROMAGNETIC RADIATION ON TEMPERATURE OF MONODISPERSE AEROSOL MEDIUM

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 19, No 7, Jul 83 (manuscript received 3 Apr 81, after revision 14 Jun 82) pp 767-771

TOPORKOV, Yu. G.

[Abstract] A study is presented of the thermodynamic processes occurring during measurement of the coefficient of absorption of aerosol particles with a resonant spectrophone. Determination of the physics of the problem allows a

variation of temperature of the particles with time upon bombardment by modulated electromagnetic radiation to be determined, which is particularly important in the study of aqueous and water-coated particles. Solution of the problem also reveals the regularities of the behavior of the instrument as a function of the substance of which the aerosol consists, its dimensions, resonant frequency, ratio of dark to light pauses in modulation period. Figures 3; references 10: 4 Russian, 6 Western.  
[208-6508]

UDC 551.521.3:551.510.42

#### ABSORPTION BY NATURAL ORGANIC AEROSOLS IN INFRARED SPECTRAL REGION

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 19, No 7, Jul 83 (manuscript received 6 Apr 82) pp 683-695

GALKINA, L. B., LYUBOVSEVA, Yu. S., SHISHKINA, M. V. and YASKOVICH, L. G.,  
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[Abstract] Simultaneous measurements of the IR transmission spectra of the dry base and solutions of aerosol samples plus data from mass spectrometric analysis of aerosol samples were used to estimate the absorption of the organic component of a natural aerosol. Samples were collected under clean natural conditions in the Abastumani Mountains at an elevation of 2000 m in the summer of 1979 as a part of a joint Soviet-American experiment. Samples were collected by multistage impactors the air sample volume drawn through the device is about 40 cubic meters. The maximum absorption of the organic component was found to be in the 3.4 and 5.8  $\mu\text{m}$  areas. The 9.2  $\mu\text{m}$  area is used to determine the mass concentration of sulfates in submicron particles. The 5.8  $\mu\text{m}$  area is basically related to the absorption of organic components. The 3.4 and 6.8  $\mu\text{m}$  areas are determined by the CH bonds of saturated  $\text{CH}_2$  and  $\text{CH}_3$  groups of alkanes, alkenes and alkyls. Large quantities of heavy hydrocarbons were found in the submicron particles. Tables presented in the article illustrate the contribution of various organic compounds to absorption of light in the IR spectral region. Figure 1; references 22: 12 Russian, 10 Western.

[208-6508]

UDC 551.510.42:551.571:551.508.91

ELECTROOPTICAL STUDIES OF INFLUENCE OF MOISTENING OF VARIOUS AEROSOL TYPES ON DIPOLE CHARACTERISTICS OF PARTICLES

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 19, No 7, Jul 83 (manuscript received 21 Jan 82, after revision 28 Jun 82)  
pp 696-702

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[Abstract] The purpose of this work was to determine the nature of the electrical moments arising upon precipitation of adsorption layers of water onto the surface of particles of various types. The mechanisms of orientation in aerosol systems were studied using dispersion dependences of the electro-optical response in the process of changing the frequency of an oriented sine field  $\alpha(\omega)$ , the variation of  $\alpha$  as a function of field intensity  $\alpha(E^2)$ , and electrooptical responses to the effect of an orienting pulse with changing polarity  $\alpha(t)$ . An electrooptical goniopolarimeter was used for the measurement of electrooptical effects. The salt aerosol was obtained by dispersing of 25% aqueous salt solution with a pneumatic dispersing unit and subsequent drying of the drops in a diffusion dryer. An MgO aerosol was obtained by burning a standard charge of metallic magnesium in a closed volume. It was found that the orientation of nonspherical MgO and NaCl, KCl particles was determined by the total effect of constant and induced dipole moments of the particles parallel and perpendicular to each other for the two systems. With low relative moisture content particle orientation is primarily determined by the contribution of the permanent dipole moment. An increase in relative humidity is accompanied by appearance of additional electrical polarizability in the two systems, the characteristic relaxation times of which indicate its surface nature. Figures 4; references 8: 4 Russian, 4 Western.

[208-6508]

UDC 551.593.52

ROTATIONAL SPECTRUM OF  $(H_2O)_2$  DIMERS UNDER ATMOSPHERIC CONDITIONS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 19, No 7, Jul 83 (manuscript received 12 Feb 82) pp 703-708

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[Abstract] The distribution of intensities in the rotational spectrum of  $(H_2O)_2$  were measured over a broad range of frequencies, 0-100  $cm^{-1}$ , including both parallel and perpendicular bands. The upper boundary of the rotational spectrum measured corresponds to the energy of rotational transitions close to the energy of the lowest frequency oscillations of the dimer. Calculations

were performed for a number of temperatures, both near normal conditions and very low temperatures (60 K) characteristic for conditions of adiabatic cooling in expanding jets. Calculation of dimer absorption can be used to interpret the absorption of low-frequency radiation in the atmosphere within the framework of the dimer mechanism, achieving satisfactory agreement with all known data on the properties and abundance of water dimer molecules in the atmosphere. Figures 4; references 19: 8 Russian, 11 Western.

[208-6508]

UDC 551.501.724:551.501.771:535.375.56

#### VARIATION IN Q-BRANCH CONTOUR OF RAMAN SCATTERING SPECTRUM OF WATER VAPOR WITH TEMPERATURE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 19, No 7, Jul 83 (manuscript received 8 Dec 81, after revision 29 Jun 82) pp 709-715

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[Abstract] The method of Raman spectroscopy was selected to study the formation of long-lived water vapor molecule clusters connected by hydrogen bonds in the atmosphere. This work presents theoretical and experimental studies of the variation in the water vapor Raman spectrum Q-branch contour as a function of temperature. Methods are suggested for determining temperature and concentration of water vapor based on the ratio of the intensities of two peaks for temperature and the intensity of one peak for concentration. An equation is presented for computing the temperature. The possibility is demonstrated of determining both temperature and concentration of water vapor from the shape of the Q-branch of the Raman spectrum. Figures 5; references 18: 5 Russian, 13 Western.

[208-6508]

UDC 551.508.91:551.510.42

#### ERRORS IN MEASUREMENT OF SCATTERING COEFFICIENT BY CLOSED-VOLUME NEPHELOMETERS

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 19, No 8, Aug 83 (manuscript received 25 Feb 82) pp 882-885

SIDOROV, V. N., GORCHAKOV, G. I., SVIRIDENKOV, M. A. and YUDIN, N. I., USSR Academy of Sciences, Institute of Atmospheric Physics

[Abstract] Measurements were performed of four components of the light scattering matrix by atmospheric air for 5 scattering angles at 546 nm wavelength using a flow-through polarization nephelometer. This report studies

certain results of measurement of the coefficient of directed light scattering  $D_{11}$  for scattering angle  $45^\circ$ , which correlates well with the volumetric scattering coefficient  $\sigma$ . The scattering coefficient was calculated using the regression equation  $\sigma \sim 9.0 D_{11} (45^\circ)$ . The polarization nephelometer was calibrated with freon-12 and pure air, allowing determination of the scattering coefficient of the air and the dispersed aerosol phase in absolute units with a random error  $\Delta\sigma/\sigma = \pm 0.1$ . Requirements which must be satisfied by closed-volume nephelometers to minimize error resulting from such factors as uncontrolled heating of the air in the closed volumes are outlined. Figures 5; references 8: 5 Russian, 3 Western.

[215-6508]

UDC 551.508.769

#### STATISTICAL METHOD OF CALCULATING MOLECULAR ABSORPTION

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 19, No 8, Aug 83 (manuscript received 5 Apr 82) pp 824-830

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[Abstract] A statistical prediction is suggested for transparency characteristics for vertical and sloping paths based on known values of these parameters at the earth's surface. The linear extrapolation method is used to write the initial prediction equation for the absorption coefficient as a function of altitude. As an example, the statistics of the absorption coefficient are studied for monochromatic radiation with a wavelength of  $10.6 \mu\text{m}$  and the optical thickness of a vertical atmospheric column is predicted for this wavelength. The method of statistical prediction of molecular absorption based on the value of absorption at the surface which is suggested can significantly reduce the error in comparison with traditional methods of estimation of transparency characteristics utilizing the mean value of the predicted parameter. Figures 2; references 12: 10 Russian, 2 Western.

[215-6508]

UDC 551.510.42:551.521

#### SPACE AND TIME VARIABILITY OF TROPOSPHERIC AEROSOL ABSORPTION INDEX BETWEEN 0.4 AND $2.2 \mu\text{m}$ WAVELENGTH

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 19, No 8, Aug 83 (manuscript received 23 Mar 82, after revision 13 Aug 82)  
pp 831-838

CHAPURSKIY, L. I.

[Abstract] The absorption index of tropospheric aerosol in atmospheric masses of various origins, including dust storm conditions, is estimated based on data from aircraft measurements described and summarized in previous works.

The conversion from the effective absorption characterizing the absorption of descending and ascending solar radiation by the atmosphere to the aerosol absorption index, describing the absorption of direct solar rays by the same layer of the atmosphere, is performed considering the index of continual absorption of water vapor and the mean cosine of the radiation. An experimentally observed maximum in absorption by the tropospheric aerosol in the near-IR spectral region is related to differences in the chemical and particle-size composition of particles, both natural and anthropogenic. Results of measurement and calculation of absorption indices for aerosol particles precipitated on impactor substrates indicate nondependence of aerosol absorption on wavelength in the 0.5-1  $\mu\text{m}$  spectral region. These results do not agree with direct measurements of aerosol absorption from aircraft and balloons. Production of complete and accurate data on the optical properties of the atmospheric aerosol requires organization of experiments for simultaneous measurement of the parameters of absorption and scattering of sunlight using aircraft spectrometers equipped with rotating heads and sun tracking systems. Figure 1; references 22: 20 Russian, 2 Western.

[215-6508]

UDC 551.508.91:551.521.3

#### DYNAMIC RANGE OF RESONANT SPECTROPHONE

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
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pp 839-844

TOPORKOV, Yu. G.

[Abstract] The relative sensitivity of a resonant spectrophone is analyzed on the basis of data from an earlier work which presented a solution for a monodisperse aerosol, extended to the case of a polydisperse aerosol. Assuming the Junge particle-size distribution in the polydisperse aerosol, the dynamic range is calculated for light with a wavelength of 0.51  $\mu\text{m}$ . The results obtained indicate that where  $\eta=2$  the quantity of large particles is great, so that the influence of smaller particles is not significant. Where  $\eta=6$ , the function  $f(r)$  decreases rapidly with increasing particle size  $r$  and most of the particles have  $r < 0.5 \mu\text{m}$  so that the ratio  $S(\eta=6)/S_0$  is close to unity, and the change in the form of  $f(r)$  where  $r < 0.1 \mu\text{m}$  does not cause a change in this ratio. It is thus concluded that as the steepness of the drop in the function  $f(r)$  increases with increasing  $\eta$  the range of  $R_{\max}$  values up to which correct measurement of the coefficient of absorption of the suspended aerosol is possible with the resonant spectrophone increases quite rapidly and at high values of measurements are possibly with high resonant frequencies, resulting in a significant increase in spectrophone response. Figures 3; references 8: 3 Russian, 5 Western.

[215-6508]

UDC 551.511.3:551.596

EVOLUTION OF NONLINEAR WAVE TRAIN AGAINST BACKGROUND OF UNSTABLE SHEAR FLOW

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 19, No 8, Aug 83 (manuscript received 19 May 82) pp 796-806

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[Abstract] This work is devoted to the study of weakly nonlinear disturbances propagating against a background of a stratified shear flow which is losing its stability. The approximation of an ideal incompressible fluid is used, allowing the problem to be studied by analytic methods. A specific profile with a Holmbo configuration is used. A nonlinear evolutionary equation is derived for the amplitude of the wave train, consisting of near-neutral harmonics. It is shown that the coefficient of the nonlinear term in the equation is purely imaginary. Figures 2; references 15: 6 Russian, 9 Western.  
[215-6508]

UDC 551.510.42:551.571

SIZE VARIABILITY OF DISTRIBUTION OF PARTICLES OF LOW-ALTITUDE AEROSOL

Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 19, No 8, Aug 83 (manuscript received 2 Feb 83) pp 807-812

METREVELI, D. M., GORCHAKOV, G. I., LOMADZE, S. O. and ROZENBERG, G. V.  
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[Abstract] Results are discussed from measurement of the size distribution of particles in the range 0.2 to 1.1  $\mu\text{m}$  performed at various times of year near Moscow, in Moscow and in an arid zone in Tadzhikistan. This is the range of particle dimensions in which there is a partial overlap of the distribution function by dimensions of coarse and submicron fractions, indicating that the nature of the distribution should be strongly dependent on the relationship of the parameters of these fractions and quite sensitive to condensation processes which alter these relationships. Measurements were made near the ground by means of a dual beam photoelectric particle counter. Graphs of sample distribution functions are presented. It is found that in the range of studied diameters the size distribution of particles is quite variable and quite sensitive to geographical and meteorological factors. Figures 4; references 12:  
9 Russian, 3 Western.  
[215-6508]

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